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CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . VICE-PRESIDENT
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

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THE SURFACE-CONTACT SYSTEM CONDEMNED IN LONDON.

Our London exchanges report the condemnation of the surface-contact system installed this year by the London County Council in place of a horse-car line on High street, Whitechapel. This at first seems to be a natural consequence. At least it has been the result of numerous other attempts to install similar systems. Indeed, so many attempts to develop a successful surface-contact system have been abandoned for one reason or another that it was a surprise when the London authorities decided to give such a system a trial. But if the accounts given of the method followed by the council in installing this system are accurate, it is evident that it was not given a fair trial, and engineering opinion should be held in abeyance until the tangle in London has been unraveled.

The system which was tried is known as the "G. B." system, and it has been in operation for nearly three years in Lincoln, England, apparently with success. We gather, from our exchanges, that the London County Council has reached a point where it must consider some other than the conduit system because of the enormous expense of installing the latter. It first considered the introduction of the overhead trolley system on this line, but met with severe opposition from the residents along the route, and it therefore decided to give the "G. B." system a trial, thinking that if this proved satisfactory all would be well; and, if it did not, the council could then proceed to install the overhead wires, since it could then say that the only other available system had been tried and had failed. It will be recalled that one reason given for the trial of the surface-contact system was the presence of an underground line along part of the route, and there was not room enough between the top of the tube and the surface of the ground for a conduit.

Be this as it may, from the accounts of the method which the council followed when installing the contact system, it seems clear that the responsibility for its failure rests entirely upon the council and not upon the system. The council's engineers refused to accept advice from the engineers who had had experience with the system, and altered the apparatus and installed parts condemned by the engineers of the company, although the latter had retained the power to condemn any part of the apparatus installed. After the council had notified the company of its intention to abandon the system the company offered to reconstruct it at its own expense and operate it for one year, at which time the council should decide whether it were successful or not, but this proposal was rejected. Evidently we have not

heard the last of this matter, since the company can not afford to accept defeat so easily.

Aside from this particular dispute, the London County Council evidently has a troublesome question to answer. It can not go on forever constructing conduit lines, and the people of London apparently will not hear of the overhead trolley. Just how it will get out of this difficulty remains to be seen, but it will not help matters if, as one of our London contemporaries hints, it tries other systems with the expectation, if not the determination, that they shall fail.

THE GASOLENE-ELECTRIC DRIVE FOR VEHICLES.

A short time ago we discussed the proposed application of electrical transmission to ship propulsion and commented upon the paper read recently by Mr. W. P. Durtnall before the Institution of Marine Engineers in London. In spite of the losses necessitated by the double transformation involved in this system, Mr. Durtnall apparently made out a very good case for the electric motor. If his figures be accepted the electric system will save largely in weight of the propelling machinery due to the smaller boiler equipment required when the turbines and propellers may both be driven at their most efficient speed. When this is the case the increased economy of both turbines and propellers so reduces the demand for steam that the boiler equipment is considerably smaller than for the direct steam drive, and since by far the greater portion of the weight is in this part of the equipment, the total weight of machinery is reduced by more than 100 tons in the instance mentioned, and there is, in addition, a very appreciable saving in fuel.

Following shortly after this and, perhaps, inspired by Mr. Durtnall's paper, Mr. Frank Broadbent, in the *Electrical Review*, of London, for July 24, discusses the application of the electric drive for propelling vehicles. This system is now being tried in a number of instances, as are several other self-contained systems, so that a preliminary comparison at least may now be made, which is done here.

It is interesting to recall at this time the first attempt to utilize the electrical system of transmission for propelling a self-contained vehicle. This was the Heilmann locomotive, constructed in 1892 or thereabouts. Heilmann's idea is not entirely clear, since he installed a complete power-house on his locomotive and then attempted to use it in competition with steam locomotives for express service. He had a steam boiler and steam engine driving a generator which charged a storage battery on the locomotive and drove the motors, which were geared to the locomotive axles. At that time he did not have the prime mover which to-day seems to promise best for such service, that is to say, an internal combustion engine. Just how large this equipment was we do not now recall, but it probably was considerably too small for the use to which he put it. Moreover, one of the great advantages of such a system, if, indeed, it be not the most important advantage of all, is the rapid acceleration made possible by such an equipment. Yet this characteristic was of little value for the service to which he put his locomotive; that is to say, for high-speed runs with few stops. The locomotive, if we remember correctly, never advanced beyond an early experimental stage, and the few trials made of it showed it was inadequate for the service for which it was intended. Heilmann, however, deserves the credit for the first attempt to interpose the electric generator and motor between the prime mover of a vehicle and its axles.

Within the last year or two this system has again been taken up and tried not only for railway service, but for road vehicles as well. In the article by Mr. Broadbent, referred to above, the advantages of this system for local traffic on railways are considered and the system itself is compared with other new systems proposed and being tried for such service. He has obtained some figures showing the cost of operation of a number of these systems on the Hungarian railways, where they are being tried out with the view of determining whether any one of them will prove satisfactory for handling the traffic on these roads. As is to be expected, the electric system, involving as it does a double transformation, shows a slightly higher fuel cost than do some of the more direct systems, but the reliability and the doing away with heavy gearing, as well as protecting the prime mover from shocks, so reduce the cost of maintenance that the total cost for operation is less for the electric system than for the others. For example, it has been found that a steam equipment showed a total cost of operation of six and one-quarter cents a car-kilometre, while a gasolene-electric equipment costs only 5.75; moreover the cost for this steam car is the average of over a million and a half kilometres of running, while that of the gasolene-electric cars is for a service of less than one-tenth this. It seems likely that the average for the electric system will be reduced upon longer trial.

These figures, as well as others given by Mr. Broadbent, show the advantage of the gasolene-electric system, although it would not have been surprising if there had been less difference between the two, or even if the total cost of operation for the steam car had been found to be little less than that of the other. It is in other ways that the electric system gains most. The system of control is simple, and makes it possible for the driver to run at almost any speed necessary, and to do so efficiently; and it is hardly necessary to add that for short hauls and many stops the rapid acceleration given by the electric motor is a very great advantage, for on this depends largely the schedule which can be given on any such line.

Mr. Broadbent points out also the advantages of the mixed system for road vehicles. A self-propelled car equipped in this way has all the advantages of the electric automobile and is limited in its distance of run only by the fuel which it can carry. For city traffic the perfect control which the driver has over his car is most valuable. He can reduce the speed to a mere crawl without reducing the torque developed by his motors. He can start quickly and thus work his way along the street much more effectively than can be done with other systems; and, here again, the substitution of the electric transmission for gearing eliminates an expensive and weak part of the car equipment.

Mr. Broadbent believes that some such system will demonstrate its superiority for city service, and replace, to a large extent, the more direct but less satisfactory systems now in use.

It is perhaps proper to state here that this system was tried some years ago and was found to operate well. In fact, an automobile equipped with a gasolene-electric drive was entered in the New York-Boston endurance race, which took place in October, 1902. It is much to be regretted that for several reasons this car did not make a very good showing, although no fault whatever could be found with the electrical part of the equipment. The owner of the car had ordered a new engine and did not receive it until the day before the race, and when installing it hurriedly a nut fell into the cooling water system which smashed the impeller of the circulating pump, so that the engine got hot and refused to run after about an hour's service. This fault was not located until too late. But until the engine became overheated the car ran without a hitch.

Mr. Broadbent's stand is well taken; and, if it be borne in mind that the gasolene-electric system has been tried for a short time only, and not all of the weaker points have been perhaps sufficiently strengthened, the possibilities of the system may be imagined. Those who remember the hard and disheartening struggle to introduce the electric street car will not be discouraged by the first few failures. It is true that we know much more about the propulsion of vehicles to-day than we did twenty years ago, but we still have much to learn, particularly in the field of self-propelling road vehicles and in the use of self-contained cars for light railway service.

DIRECTIVE WIRELESS TELEGRAPHY.

From time to time we have noticed various attempts to control the direction of propagation of electric waves employed in wireless telegraphy. One or two of these are reported to have shown satisfactory results during experiments and have even been employed in actual service. On another page of this issue a new system is described due to Dr. F. Kiebitz, who has patented his system in Germany and has obtained experimental results which, although resulting from trials on a rather small scale, are encouraging. The method in brief consists in setting up an oscillating magnetic field at an angle of about sixty degrees to an oscillating electric field. The result is the production of electric waves having a maximum amplitude in the direction normal to the two directions of oscillation.

Such a system, of course, radiates in all directions, but it is stated that the intensity of radiation in the maximum direction was seventy times that in the minimum direction, and at an angle of forty-five degrees to the maximum direction the energy of radiation was only one-third of that in the maximum direction.

The value of controlling the direction of radiation of wireless signals is great, but it is well to remember that this control can be secured through fairly wide angles only. In the present instance it is probable that all apparatus which would operate satisfactorily in the direction of maximum transmission would also be affected within thirty degrees on either side of this direction, and hence not more than two such systems could be operated successfully if tuned to the same pitch in the same territory. The system, of course, radiates symmetrically about one axis, sending out equal maximum radiations in opposite directions. And another point which must not be overlooked is the variability of wireless signals during the day, so that the only way to be sure that the signal will reach the receiving instrument is to be sure that it is strong enough. Obviously such a system of operation is not conducive to directive control of transmission.

CONCRETE POLES FOR ELECTRICAL TRANSMISSION.

The increasing price of timber for all constructional purposes presents a serious problem to the engineer. Hence any method of preventing decay which will reduce the total cost of the lumber is acceptable. But the problem is being attacked in further directions, and many engineers are seeking substitutes for wood. One of the most promising materials for this purpose is concrete reinforced by steel. With this material the use of wood may be frequently avoided, and, indeed, with a proper method of construction the reinforced concrete may be made to take the place of wood in cases where it might at first seem to stand no chance. For example, reinforced concrete poles are now being used with reported success not only from the constructional standpoint, but from that of the cost as well. Elsewhere in this issue is described a method of constructing hollow poles of reinforced concrete, which has been employed in Germany. Not only is the pole thus formed a very satisfactory device for supporting an electric line, but it is estimated that such a pole would have a life of fifty years without, in that time, having cost anything for maintenance. On such a basis the cost for the pole during that time would be less than half what it would cost to maintain either an iron or a wooden pole in the same position.

DECREASE IN STEAM AND ELECTRIC RAILROAD EARNINGS COMPARED.

A comparison of the earnings of six important street railways and an equal number of steam railroads for a three months' period during the last six or eight months brings to light several interesting facts. Gross earnings of the six street railways during the period aggregated $14,012,170, against $14,025,477 in the same months of the previous year, a decrease of $13,307, or less than one-half of one per cent. Gross receipts of the six steam roads, on the other hand, for the three months' period aggregated but $79,840,909, against $95,473,826 in the same months of 1907, a loss of $15,623,827, or over nineteen per cent.

The explanation of this is to be found in the different character of traffic of electric and steam roads. Ninety-five per cent of the gross earnings of electric railways is derived from passenger receipts, while from sixty-five to seventy per cent of the steam railroad gross is realized from freight. In periods of universal curtailment, therefore, the freight earnings are one of the first to indicate such substantial depression.

Convention of the Michigan Electric Association.

The annual convention of the Michigan Electric Association was held at Grand Rapids, Mich., August 18, 19 and 20. Headquarters were established at the Hotel Pantlind. The meeting was called to order by President H. W. Hillman on the morning of August 18.

The chairman of the Board of Public Works, Mr. Prestley, on behalf of the mayor, welcomed the members to the city.

The presidential address recommended a change in the constitution to permit the election of associate members and also outlined a plan for increasing the membership.

The first topical discussion was entitled "Various Experiences with Tungsten Lamps." E. F. Phillips, of the Detroit Edison Company, related that company's experience in lighting the suburban village of Grosse Point with tungsten lamps, supplying current through an underground system 11,500 feet long. Forty-two ornamental iron poles with brackets and with two lamps on each pole were erected. The contract called for at least fifty-candle-power lamps. The company installed, last November, sixty-candle-power, seventy-five-watt series tungsten lamps, each lamp taking five and one-half amperes. These were alternating-current lamps. The renewals for burned-out lamps threatened to become a burden. The company finally dropped the current consumption to five amperes, and obtained very satisfactory results. The service is eminently pleasing to the customers, and the company is satisfied with the system as it is now operated.

F. T. Masterson, of Grand Rapids, described the series tungsten-lamp system on Canal street, in Grand Rapids. This installation consists of fifteen spans across the street, with eighteen sixty-candle-power, seventy-five-watt lamps in series on each span. The spans are spaced 100 feet apart. All of the material, except the lamps, is owned by the Canal Street Merchants' Association. The lamps and current are furnished by the Grand Rapids-Muskegon Power Company. The initial expense of installation for material and labor was about $50 a span, or $750 in all, divided among so many merchants that the individual expense was small. The power company, representing itself as one of the merchants because of a small retail store, stood its *pro rata* share of the expense. The Grand Rapids Electrical Company, a supply dealer, secured the contract for erection and furnishing the material. The installation is permanent.

The proposition appears to be very attractive from the standpoint of the merchants and is considered a forcible advertisement for their businesses. Since the installation was made the crowds of people who flock to that street offer ample evidence of its success from an advertising point of view. The expense for operation is divided among so many merchants that some of them do not pay more than $1 a month. The power company made a special feature of billing separately to the merchants, thus making the least trouble to the association. In view of dealing with a merchants' association, it appeared necessary for the company to make a contract price based on renewal and maintenance of lamps. The power company would not care to take additional business of a similar character at less than $7 per lamp per year.

William Chandler, of the Sault Ste. Marie Electric and Power Company, related the experiences of his company in a paper prepared by himself and D. B. South. The company has noted no bad effect upon the lamp from voltage fluctuations, although its regulation is quite good. The company was one of the first to make any considerable installation of tungsten lamps in a commercial way. Notwithstanding some drawbacks incident to some manufacturing defects in the early type of lamp, there seems to be no reason to doubt the wisdom of the company's decision that the thirty-volt series type of lamp is the best to use. A special fixture burning four forty or fifty-candle-power lamps in a cluster was also decided upon. The company's first order was for lamps taking from fifty-five to fifty-seven watts per lamp and giving about forty candle-power. While these gave a fine illumination, they could not be made to compete in cost with the gas arc, as the company desired, under its operating conditions. The company has had better satisfaction with the forty-candle-power lamps, and some of these have been burning 1,400 hours, with little if any diminution of light.

The company adopted the plan of either selling the lamp outright at $1.50, or renting a set of four at fifty cents per month and maintaining the lamps. This places them on the same basis as gas arcs in the city, or less, as far as the cost of service is concerned, but in quality the illumination from gas can not be compared with the tungsten lamps.

The company has made no attempt to secure residential lighting with tungsten lamps, and does not believe that the series method of installation would meet with much favor in such lighting.

The paper also described a number of installations where the tungsten lamp had satisfactorily displaced installations of gas arcs.

H. A. Chase, of the Hart Electric Light and Waterworks, Hart, Mich., read a paper entitled "Street Lighting by Tungsten Lamps." The city of Hart is thickly lined with shade trees, making it almost impossible to illuminate the streets with arcs and procure an even distribution of light. It was decided to try lighting the main street with tungsten lamps. This trial of twenty lamps gave such excellent satisfaction that the company has now sixty-two tungsten lamps installed, and expects within a year to have the village lighted throughout with the same type of lamp. Sixty-candle-power, seventy-five-watt series tungsten lamps were used, placed three to the block alternately across the street. This spaces the lamps about 150 to 200 feet apart. The lamps are placed about twelve feet from the ground, giving a fine distribution of light. On one street, where there are no trees for about half a mile, lamps have been placed on every other pole, spacing them about 300 feet apart. This gives almost as much satisfaction as the shaded streets with the lights nearer together. Through the business part of the town series alternating-current arc lamps were used on the same circuit with the tungsten lamps.

The first twenty lamps have burned 464 hours with only three burnouts. The first lamp that burned out had burned for ninety-two hours; the second, 182 hours, and the third, 184 hours. The last forty-two lamps installed have burned 180 hours with two burnouts. The first burned out after twenty-five hours and the second after 140 hours.

Mr. Chase believes that the cost of installation is a little more than with arc lamps, but when the difference in the distribution of light is compared, the extra cost is not to be considered. The cost of installing sixty-two tungsten lamps and four arc lamps, including reconstruction of the old lines and one Fort Wayne twenty-five-light arc regulator switchboard and transformer, and three-quarters of a mile of new line, was $2,252. While there was quite a little breakage in the first shipment of lamps, the supply company made up this breakage in full. The campany has one lamp which has fallen twice to the ground, a distance of twelve

feet, and is still burning. This is a rather remarkable evidence of the present strength of the lamp and an indication of the future perfection that may be attained.

A. C. Marshall, general superintendent of the Port Huron Electric Light and Power Company, stated that shortly after the multiple tungsten lamps came on the market it became evident that there was a considerable demand for the new form of lamp. The company laid in a stock of sixty and 100-watt lamps and sold them at list price. The company also sold Holophane reflectors with each lamp, and recently the company's customers are making quite a demand for the tungsten lamp, as a considerable reduction is found in the cost of lighting. Mr. Marshall thinks that from the present outlook it is going to be hard after a while to get enough new business to keep offsetting the reduction in the old customers' bills. The merchants are now lighting their whole stores for what it previously cost them to light the windows only. He does not think it practicable to recommend tungsten lamps for residence lighting.

Alex Dow, vice-president and general manager of the Edison Illuminating Company, of Detroit, suggested that anything that would reduce the cost of wiring the ordinary small residence should be looked into very carefully. The small householder is afraid of the cost of electric lights. At the same time the company can not afford to stand the expense of making such an installation purely for the return which may be made by the purchase of current.

W. J. Trott, Michigan manager of the Fostoria Incandescent Lamp Company, described the recent improvements in tungsten lamps.

Darwin D. Cody, of the Grand Rapids Electric Company, related some experiences with the tungsten lamp, his opinion being entirely favorable.

F. T. Benson, manager of the tungsten lamp department of the Chicago office of the General Electric Company, said that perhaps the new 250-watt tungsten will in many cases take the place of the arc lamp for street lighting. Experiments were being conducted with a view of strengthening the filament, perhaps by alloying the tungsten with other metals. No definite statement concerning this matter could be made at this time.

George D. Westover, manager and chief engineer of the Cadillac Water and Light Company, said he believed in going after the small-residence lighting consumer. He has 300 customers on his books who do not earn wages exceeding $2 a day. These workmen are able to afford electric lights in their homes. He uses one transformer in the centre of a block of houses. A meter is installed for each customer and the company gets from $9 to $15 from each user of this class per year.

The meeting was adjourned until Wednesday morning after a brief executive session.

On Tuesday evening Dr. C. P. Steinmetz delivered an interesting lecture on "Lightning Phenomena." The lecture was illustrated with lantern slides and was enjoyed by a large number of guests in addition to the official attendants at the convention.

At the Wednesday morning session Dr. Steinmetz reviewed the development of electrical transmission systems during the past twenty-five years and made frequent references to the 100,000-volt line of the Grand Rapids-Muskegon Power Company.

C. L. Crosby read a paper entitled "Campaigning for Power."

Mr. Crosby holds that the first and most essential movement in dealing with the prospective customer is educational. The successful solicitor should understand steam engines, as in this way he is able to determine the actual effective power required, as well as the friction loss which might be excluded by the use of motors. By this means he may arrive at a very close estimate of the cost of operation by electricity. It is necessary also that he be familiar with the operation and efficiencies of gas engines under different load conditions. In competing with gas engines, the solicitor will find that his prospective customer very seldom figures any cost other than the gas bills sent him each month, and here it is necessary that the electrical solicitor demonstrate in as impressive a way as possible the cost for lubrication, cooling water, repairs, attendance, etc. The solicitor should be able to furnish to the customer figures not only on the cost of service, but also on the cost of motors, wiring, etc. He should be able to lay out the most satisfactory method of driving the shop, at the same time avoiding the installation of more power than is necessary. He should know the type of motor best suited for various types of machinery. The office should co-operate with the field force in handling customers, practising courtesy and attention with all inquirers.

A. C. Harris read a paper entitled "Electric Power Installation in a Wood-Working Plant." This paper described particularly the electrical devices used by the Grand Rapids Hand Screw Company.

Guy Lewis, manager of the Lewis Electric Company, of Grand Rapids, read a paper entitled "Ideal Relations Between the Central Stations and the Contractor."

Mr. Lewis is of the opinion that the central station should do no construction work except on very small jobs where it comes into close competition with the gas company. Central station solicitors should obtain house-wiring and other contracts and turn the work over to one of the local contractors. In return for this consideration the contractor should establish a schedule of prices for wiring houses and other small buildings that will be equitable to all concerned. This schedule should be used by the central station solicitors in going after all work. The contractor should use his influence in every way to create satisfied customers for the central station. It will be possible for him to allay much criticism that is unjustly directed at the central station. The central station should show consideration for the contractor and supply dealer in giving the latter a list of prospective motor and apparatus customers, so that all might be a solicitor for the man who wants to distribute current. The central station should place itself in a position not to do anything to reduce the contractor's profit, or in any way belittle him. The contractor therefore would have greater consideration for the central station, would exercise more care in the installation of apparatus, and reduce dissatisfaction and irritation.

In the afternoon the ladies visited the Air Dome, and the gentlemen inspected the high-voltage transmission system of the Grand Rapids-Muskegon Power Company. Visits were also made to the Grand Rapids Plaster Company's plant, and to the plant of the Fox Typewriter Company.

The closing session was held on Thursday morning. A paper was read by A. J. Mott, entitled "Electric Heating Devices."

Mr. Mott related the experience of a company in an eastern city where there was a good lighting load and a moderate day load of small motors. In its effort to increase the day load the company arranged for a kilowatt-hour rate of five cents to all persons who wired up separately for a complete kitchen outfit or luminous radiator, installing a separate meter, with a minimum rate of $1 per month. A demonstration was started in a large department store, this demonstra-

tion being advertised in the daily papers with full-page announcements. The direct results of this demonstration were not satisfactory, although it later proved to have been a very good advertisement. It was decided to start a house-to-house campaign, and a wagon and three boys were sent out, leaving a flat-iron in every other house or apartment. The wagon put out about twenty-five irons a day, and at the end of three weeks the company began to take them in again. On some days the company would collect twenty irons, and on other days none at all would come back. The average showed that over twenty irons out of each twenty-five were retained. Efforts were also made to install sewing-machine motors, percolators, water heaters and chafing dishes, and at the end of the summer campaign the company had out about 800 electric flat-irons, nine complete cooking outfits, twenty percolators, thirteen luminous radiators, thirty sewing-machine motors and thirty-five chafing dishes, besides a considerable number of water heaters and cigar lighters. The income amounted to $6 per year for each flat-iron, $48 per year for each kitchen outfit, $12 per year for each luminous radiator and $1 a year for each percolator and sewing-machine motor. The smaller articles, such as chafing dishes, hot-water heaters and cigar lighters, do not bring much income directly to the central station, but are good advertisements for the larger articles, from which an income can be derived.

Charles O. Blackford read a paper entitled "Electric Display Windows for Effectively Advertising Electricity."

Mr. Blackford thinks that many people do not realize the great number and beauty of the latest art-glass fixtures. A display of beautiful fixtures and portables in the window of the central station company's office proves to people the great opportunity offered to them for decorative purposes. If an electric company is successful in having beautiful and attractive displays, other merchants and dealers will comment on them, and they, too, will use something electrical in window trimming. The benefit received from such displays can scarcely be overestimated, because nearly everybody can use electric power in some way. The advertising man and the window trimmer should work together. In electric window trimming it is almost imperative to have motion, because electricity is energy. Something moving in the window will attract more attention and receive more thought than anything beautiful and artistic.

Errett L. Callahan read a paper entitled "Popularizing the Use of Electricity."

This paper describes the way in which a good deal of profitable central station business can be secured by fitting up a proper equipment for demonstration purposes and carrying on a campaign to bring to the notice of prospective customers the advantages of electric service. The plans which have proved of value in a number of cases are outlined, and reports are given from a dozen cities throughout the country where very successful campaigns for increasing the use of electricity have been carried out.

A paper was also read by John G. Gromberg, entitled "Electricity and the Fireless Cooker."

The following officers were elected:

President, H. W. Hillman, Grand Rapids.

Vice-president, F. B. Spencer, Sheboygan.

Secretary-treasurer, A. C. Marshall, Port Huron.

A number of manufacturers of electrical devices made attractive displays, the Nernst Lamp Company making an exhibit of a full line of the new Westinghouse-Nernst units. The many new features of these lamps, especially the screw burners and the wafer heaters, made an exhibit of unusual interest to the electrical men present.

The Westinghouse Electric and Manufacturing Company occupied a tastefully arranged booth at the end of the main corridor at the Pantlind Hotel, adjoining the convention headquarters.

Report on Ventilation for the New York Subway.

Bion J. Arnold, consulting engineer for the Public Service Commission, has submitted to that body a report on cooling and ventilating the subway.

Mr. Arnold says the most available ways of reducing the temperature are: First, refrigeration; second, cooling by water; third, blocking the automatic louvres open, and providing additional openings; fourth, frequent air changes by train movement and by the use of a centre wall, dividing the north and south bound tracks.

The report describes the four methods, and discards the first and second as being impracticable, under the circumstances, and then makes the following recommendations:

Block the present louvres open during the day, and allow them to operate at night when the fans are being run. Construct as many protected openings as practicable between the subway and the street. At the Fourteenth street and Grand Central stations install large disc fans to draw air from the street through the kiosks, and force this air in large volumes down upon and among the persons waiting for trains upon the platforms. Construct a solid, continuous division wall between the down-town and up-town express tracks, extending from the north end of Ninety-sixth street station to and including Brooklyn Bridge station. For the purpose of demonstrating the feasibility of such a wall, it is suggested that the section extending south from the centre wall now at Thirty-third street station be constructed first far enough south to include the Fourteenth street station. At stations, the upper half of the wall to have vertically sliding counterweighted windows between columns. The cost of a four-inch terra-cotta brick wall between Ninety-sixth street and the Brooklyn Bridge should not be over $76,000, or $2.25 per running foot. The cost of a concrete wall in the same section should not be over $130,000, or $3.85 per running foot.

The commission will probably hold a conference with the Interborough representatives before acting upon Mr. Arnold's recommendations, as the building of a wall of the kind described would increase the bonded debt, and, therefore, the rental of the subway.

The Electrical Equipment of the Ferndale Collieries, South Wales.

The Ferndale Collieries are situated twenty miles north of Cardiff, Wales, in one of the Rhondda valleys. They include a series of pits dotted over some three miles along the bottom of the valley. Their yearly output amounts to nearly one and three-quarters millions tons and they employ about 6,500 men. In order to secure greater efficiency in the operation of the many power-consuming appliances, the steam drive has been abandoned recently for the electric drive. A modern generating station has been installed at Tylorstown, at the lower end of the series of pits, and power is distributed from it at 6,600 volts to transformer substations at the different pits. The power-house is a handsome steel and brick structure equipped with every modern appliance. It contains four water-tube boilers with superheaters, each capable of evaporating 30,000 pounds of water an hour at 150 pounds pressure and 150 degrees Fahren-

heit superheat. Each has underfeed mechanical stokers and operates under forced draft. A complete coal-handling system has been installed to take the coal from the cars and deliver it to the bins, whence it is fed by gravity to the furnaces. The water supply is pumped from one of the pits. The engine-house equipment consists of three Sulzer cross-compound engines, each rated at 2,500 horsepower and coupled to three Lahmeyer three-phase flywheel-type alternators, running at ninety-four revolutions a minute. There are three cooling towers through which the water is circulated by pumps driven by sixty-horse-power induction motors of the slip-ring type. The cooling towers are thirty-three feet in diameter and eighty-three feet high. The main generators are rated at 1,600 kilowatts at eighty-five per cent power-factor. The overload rating is twenty per cent for two hours, or thirty per cent for half an hour. Excitation is furnished by a steam-driven set of seventy kilowatts rating and a motor-generator booster set rated at 120 kilowatts, which also charges the exciting battery. The battery can also be charged by the steam-driven set if necessary. The switch gear is arranged in three galleries at one end of the engine room. The operating gallery is the middle one and consists of a benchboard of three panels and a series of seven feeder pillars. The switch handles are of the loose type, mechanically coupled to the oil switches on the gallery below. The feeder pillars control three transmission lines, the station supply and the supplies to four of the pits. The distributing stations have, in general, three floors. The transformers are on the ground floor, the switches on the second and the lightning arresters on the third. The potential is lowered here from 6,600 to 2,200. At the pits it is again lowered to 440 for motors and surface lighting. Twenty-two hoisting gears are being installed, driven by motors varying in rating from 200 to 50 horse-power. These are of the main-and-tail type, driven mostly by slow-speed, single-reduction gears, though in some cases double-reduction gearing has been necessary. The speed is about six miles an hour. A flexible coupling between the motor and gearing absorbs the shock of starting. These gears have proved to be reliable and easy to control. The underground pumping is now done by motors driving three-throw and high-lift centrifugal pumps. At one pit an Ilgner hoisting set has been installed which will raise 1,800 tons of coal a day. The ventilating fans are driven by motors, as these furnish a most desirable load. In one case there is a Sirocco fan capable of handling 300,000 cubic feet of air a minute, driven by two 300-horse-power motors, through ropes. Several similar, though smaller, fans are being installed. There is a complete telephone system connecting the generating station with the switching and transformer stations. The various mine shops have also been converted to the electric drive.—*Electrical Review (London), July 31.*

The Michigan Central's Detroit Tunnel.

One of the largest and most important projects in railroad engineering now being carried on in this country, and of which very little has been publicly said and written, is the construction of the Michigan Central's tunnel under the Detroit River at Detroit. At the present time it is about one-half completed; it is expected to be in operation by July, 1909.

Approximately one and one-half miles in length, exclusive of approaches, it will form the connecting link from Detroit to Windsor, Canada. Its cost is estimated at $15,000,000, to which must be added the cost of a new terminal at Detroit and the remodeling of the one at Windsor.

The tunnel is being constructed by the engineering firm of Butler Brothers & Hoff, under the supervision of the Detroit Tunnel Company.

The remarkable feature of the construction work is that it is being carried on according to lines entirely new. The old method of submarine tunnel construction—that of building the tube piece by piece under water by means of compressed air—has been entirely ignored. The method in use consists of building the sections at St. Clair, a point about twenty miles north of Detroit, and towing them on barges to the point at which they are to be sunk.

The sections are then permitted to fill with water and sink to a bed prepared for their reception. They are then united by divers by means of riveted flanges. This being done, the whole is enclosed in concrete, which solidifies and acts as a preservative against corrosion of the metal and protection against flooding.

The water is then drawn out by siphons, and the end tube bulkheaded, after which nothing remains but the interior work, such as the laying of a concrete roadbed, the laying of rails and conduits, etc.

The tubes, two in number, are laid side by side, one to accommodate westbound traffic, the other eastbound. The motive power will be electricity transmitted in much the same manner as that in use on the New York Central to White Plains.

Officials of the Michigan Central are confident that the project will earn its cost several times over. In the first place, the road could never be considered first-class in every particular until the present method of moving passengers and freight across the river—by ferry—is abolished. The ferriage of trains now involves a delay of from thirty minutes to almost anything, depending upon the amount of ice which, during the winter, often clogs the river.

The 1908 Electric Lighting and Illuminating Engineering Number.

The annual Electric Lighting and Illuminating Engineering Number of the ELECTRICAL REVIEW will be published September 12. This issue will be replete with interesting articles by the leading authorities in the electric lighting field, and will bring down to date authentic information concerning the development of the electric lighting industry and the present-day ideas of illuminating engineers. Some of the leading articles already scheduled are as follows: "Progress in Incandescent Lamp Development," by the engineering department of the National Electric Lamp Association and the incandescent lamp engineers of the various interests manufacturing incandescent lamps; "The New Westinghouse-Nernst Lamps," by Otto Foell, chief engineer of the Nernst Lamp Company; "Progress of Cooper Hewitt Lamps," by Dr. J. Polak; "The Kusel Colloid Lamp," by Paul McJunkin; "The Helion Lamp," by Professor H. C. Parker and W. G. Clark. Bassett Jones, Jr., contributes a masterly article treating in a philosophic vein the relations of the architect and the illuminating engineer. This article is entitled "The Illuminating Engineer as an Architectural Critic." An article entitled "The Illuminating Engineer" is contributed by Albert J. Marshall, chief illuminating engineer for the Bureau of Illuminating Engineering, New York city. Our London correspondent, A. H. Bridge, whose symposium on English conditions, published last year, attracted so much attention, will contribute a review of the conditions in electric lighting and illuminating engineering in Great Britain. In addition there will be an unusually comprehensive presentation of data concerning recent developments in flame arc lamps, tube lighting, the newer forms of incandescent units, carbon arc lamps, central station apparatus, and descriptive and illustrated matter concerning the manufacture of incandescent lamps.

So great was the interest manifested in the first Electric Lighting and Illuminating Engineering Number, published September 14, 1907, that although a greatly enlarged edition was printed, this was exhausted within a short time after the date of publication. In order to facilitate the distribution of the 1908 edition, it is requested that those desiring extra copies will send in their orders to the office of the ELECTRICAL REVIEW at once.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.

THIRTEENTH ANNUAL CONVENTION, HELD AT DETROIT, MICH., AUGUST 19-21.

The thirteenth annual convention of the International Association of Municipal Electricians was opened at the Hotel Pontchartrain, Detroit, Mich., by President R. A. Smith at noon on Wednesday, August 19. An address of welcome was delivered by Mayor William B. Thompson, and was responded to on behalf of the association by J. B. Yeakle, of Baltimore, Md.

An address by Past-President Hatch closed the morning session.

The afternoon session was opened at 1.30 and the president, R. A. Smith, then delivered the presidential address and also read a paper on "The Moving-Picture Hazard."

There is nothing of late years that has given the insurance companies more concern than the moving-picture business. The rural districts and small towns of many states are overrun with these shows, many of which are a menace to the community owing to lack of observance of the rules of the National Code. Many of these shows use machines without magazine, booth or other approved mechanisms. In the light of what has happened, it seems criminal for those in authority to ignore these conditions. The National Code contains a rule, No. 65a, which, if followed to the letter, will eliminate the greatest danger, but there are many other precautions necessary, such as licensing the operatives of the machines, proper wiring, ample exits and red lights. Various interpretations have been put upon Rule 65a as regards the proper material for the fireproof booth. The rule plainly reads "fireproof material" and means "fireproof material" such as will not warp when heated and will stand the wear and tear that booths are subjected to. Mr. Smith called attention to the rules and precautions taken by his city of Norfolk, Va. They are as follows:

"Whenever moving-picture machines are operated in any building or tent within the city limits, they shall be so located as not to obstruct the exits, aisles or passages thereto, and shall be placed in a metal chamber of galvanized iron not less than No. 24 gauge, said chamber not to be smaller than six feet square by five and one-half feet high, inside measurement. There shall be an inner and outer wall with a two-inch air space between, for sides and top, all to be riveted to a substantial iron framework. There must be a vent pipe not less than twelve inches in diameter run from metal chamber to a point outside building. Main door must be hung by stout coiled spring hinges and swing outward; openings for lens and operator must not exceed ten inches by eight inches each, and have metal drop shutters running in metal grooves, shutters to be held open by light cotton strings passing across inner ceiling of booth, through side of booth to outside. All wiring in both to be in conduits; wiring for picture machine to be separate from lighting system; all exits to have large signs and red lanterns, burning sperm oil; not less than two five-gallon chemical extinguishers to be located near booth. All machines to be in charge of competent men who shall receive a certificate from the Board of Control, said certificate to be good for only one year and revocable for cause."

Discussing this paper O'Hearn, of Cambridge, Mass., and Jerry Murphy, of Cleveland, both remarked that a larger part of the hazard from moving-picture machines was not that caused by electrical means, but resulted from causes entirely distinct. It would seem that the proper department to place the inspection was the fire department.

C. R. George, of Houston, Tex.; W. Y. Ellett, of Elmira, N. Y.; W. M. Petty, of Rutherford, N. J., and others commented upon the paper and agreed for the most part with the author.

The first paper read and discussed at the second day's session was that by W. M. Petty, of Rutherford, N. J., on "Batteries for Signaling Systems." Mr. Petty reviewed the various types of cells used for signaling work and mentioned their advantages and disadvantages. The preparation of this paper was undertaken, primarily, to provoke discussion on the storage cell, which is, par excellence, the battery for the city electrician. It can be used for any kind of work, either open or closed circuit, and, with a minimum of care and expense, can be relied upon at all times to produce a steady flow of current.

Of late years the greatest objection urged against the storage cell, that of the means for charging, has been removed, and every place, no matter how small, now has an electric light or power circuit available. Even those places where no direct current can be secured, can, by means of simple and efficient devices, convert the alternating current to direct, and thus charge the cells at a low cost.

In investigating the storage battery when used for signaling work, Mr. Petty finds by far the larger majority are the six-ampere-hour, two-plate type. The twelve-ampere-hour cell is also much in use and is increasing in popularity.

With the latest type of switchboard made by the leading manufacturers of fire-alarm and police apparatus, the cells can be grouped so as to obtain the greatest advantages from the charging current, and they can be also controlled so as to render the operations almost automatic.

The methods of charging range from direct current at 600 volts down to 110 volts, and alternating current from 220 volts and 110 volts, converting by means of motor-generator and rectifier sets down to four volts.

The cost of maintenance varies widely. Out of the many systems examined by the writer, a large majority obtain the necessary current free of charge; others pay rates varying from five to fifteen cents per kilowatt-hour, making the average cost per cell vary from ten to fifty cents per annum. In places using alternating current the efficiency of conversion varies from twenty-five to sixty-five per cent.

Mention was made of a plant the author had installed wherein he had used the mercury arc rectifier for charging the cells. This plant has been running since June, 1907, and has shown very satisfactory results. No trouble whatever has been experienced with it, and the cells are in every respect as good as when first installed. The prediction that some trouble and expense would be experienced in the operation of the tube has been proven a fallacy. As a matter of fact, the original tube, started June 15, 1907, is still in operation and shows no signs of failing. It has given over 1,100 hours' service. This installation shows an efficiency of sixty-two per cent and is run at about one-third the capacity of the rectifier.

In the resulting discussion Jerry Murphy, A. C. Farrand, C. R. George, T. C. O'Hearn, C. P. Diehl and J. B. Bernstein participated.

The matter of overcharging was touched upon, and it was shown that in the majority of cases overcharging is a very common practice. The life of the cells, even though they may be much overcharged, seemed to be in excess of six years and an instance where a cell had been in use for nine years was mentioned.

Jerry Murphy, of Cleveland, Ohio, then read a paper on "Police Telegraph Systems." This was a general paper intended to prove the value of such systems to the community, and not taking up the ques-

tion technically. This side of the problem was, however, brought out in the discussion and it was shown in many cases that a combination of the telephone and telegraph was essential to a proper system.

An elaborate paper on "Methods of Fault Location," by J. B. Bernstein, illustrated by diagrams and apparatus, was read and discussed. Mr. Bernstein reviewed the various methods of testing by means of the many forms of Wheatstone bridge and gave simple instructions regarding them.

Mr. Petty, in opening the discussion, said that the thanks of the members were due Mr. Bernstein for his very practical paper.

C. R. George's paper, on "Electrical Equipment of a Fire Station," described a system in use in the city of Houston, Tex.

The third day's session was devoted to committee reports and routine business.

The chairmen of the various departments of the organization submitted their reports, showing the progress that had been made during the year.

A resolution was passed appointing a committee of three to report on the proposed action of the United States Post-Office Department regarding the painting red of mail boxes. This committee has power to enter a protest in the name of the association against such action on the ground that it would tend to cause confusion, red being the standard color for fire-alarm signal boxes.

It was decided to hold the next convention at Atlantic City, N. J.

The secretary, F. P. Foster, was elected a life member in recognition of his excellent services to the association.

Many entertainment features were provided for the ladies and the members. The afternoon of Friday was spent on one of the river boats, with luncheon at the Casino through the courtesy of Gamewell Company.

The election of officers resulted as follows:

President—J. B. Yeakle, Baltimore, Md.

First vice-president—W. S. Devlin, New Castle, Pa.

Second vice-president—H. C. Bundy, Watertown, N. Y.

Third vice-president—F. A. Cambridge, Winnipeg, Manitoba.

Fourth vice-president—C. R. George, Houston, Tex.

Secretary—Frank P. Foster, Corning, N. Y.

Treasurer—C. P. Diehl, Harrisburg, Pa.

Executive committee—A. C. Farrand, Atlantic City, N. J.; C. A. Sundquist, Jamestown, N. Y.; L. L. Kingsbury, Baltimore, Md.; C. F. Gall, Louisville, Ky.; S. W. Manning, St. Paul, Minn.; T. C. O'Hearn, Cambridge, Mass.; R. A. Smith, Norfolk, Va.; William Crane, Erie, Pa.; John O'Brien, Fond du Lac, Wis.

Finance committee—Jerry Murphy, Cleveland, Ohio; A. L. Kittridge, New Haven, Ct.; A. L. Pierce, Wallingford, Ct.

The following committees were also appointed: Inspection—L. L. Kingsbury, R. A. Smith, T. C. O'Hearn. Police Signal—A. C. Farrand, Jerry Murphy, A. L. Kittridge. Fire Telegraph—C. F. Gall, S. W. Manning, H. C. Bundy. Electric Light—C. A. Sundquist, A. L. Pierce, F. A. Cambridge. Outside Construction—W. S. Devlin, William Crane, John O'Brien.

Among those registered were the following:

W. A. Devlin, New Castle, Pa.; C. R. George, Houston, Tex.; A. C. Farrand, Atlantic City, N. J.; A. S. Hatch, Burnside, Ky.; R. A. Smith, Norfolk, Va.; F. P. Foster, Corning, N. Y.; E. J. Hunt, New York city; L. L. Kingsbury, Baltimore, Md.; P. H. McMannus, Wilkesbarre, Pa.; C. F. Gall, Louisville, Ky.; A. C. Friend, Chicago, Ill.; R. C. Smith, New York city; R. J. Thorne, Chicago, Ill.; M. J. Donoghue, Niagara Falls, N. Y.; W. F. Wills, Niagara Falls, N. Y.; A. L. McKittridge, New Haven, Conn.; A. J. Bell, New Rochelle, N. Y.; H. C. Bundy, Walkertown, N. Y.; W. L. Kent, Lynchburg, Va.; C. P. Diehl, Harrisburg, Pa.; C. G. Sundquist, Jamestown, N. Y.; P. J. Kern, Louisville, Ky.; William Crane, Erie, Pa.; J. B. Diller, Memphis, Tenn.; Ira B. Yeakle, Baltimore, Md.; Anna Veath, Youngstown, Ohio; John Berry, Indianapolis, Ind.; Adam Bosch and Mrs. Bosch, Newark, N. J.; E. Darrow, Cincinnati, Ohio; S. W. Manning, St. Paul, Minn.; John O'Brien, Fond du Lac, Wis.; F. E. Stover, Chicago, Ill.; J. H. Warren, New Brunswick, N. J.; J. B. Bernstein, Philadelphia, Pa.; J. O. Dormer, Chicago, Ill.; J. E. Clark, Rutherford, N. J.; J. W. Whaling, Chicago, Ill.; J. B. Yeakle, Baltimore, Md.; J. C. Craig and Mrs. Craig, Toronto, Ontario; Mrs. J. L. Simpson, Washington, D. C.; C. S. Downs and wife, Altoona, Pa.; N. M. Loomis, Akron, Ohio; E. J. Loomis, Allegheny, Pa.; Ambrose Perkins, Youngstown, Ohio; W. M. Petty, Rutherford, N. J.; Mrs. P. Gykern, Louisville, Ky.; Mrs. C. Hall, Knoxville, Tenn.; Mrs. W. M. Crane, Erie, Pa.; Mrs. J. Bell, New Rochelle, N. Y.; Flora E. Hatch Detroit, Mich.; Mrs. A. Perkins, Youngstown, Ohio; Mrs. F. Quimby, Youngstown, Ohio; Fred Quimby, Youngstown, Ohio; Albert Murphy, Cleveland, Ohio; Edward Murphy, Cleveland, Ohio; Jerry Murphy, Cleveland, Ohio; F. A. Cambridge, Winnipeg, Manitoba; W. Y. Ellett, Elmira, N. Y.; T. C. O'Hearn, Cambridge, Mass.; Charles S. McCoskar, Mobile, Ala.; H. A. Bowen, Cleveland, Ohio; Mrs. A. J. Cowles, Detroit, Mich.; Lucy Peterson, Detroit, Mich.; J. W. Brooke, Cleveland, Ohio; Miss M. Buckley, Brooklyn, N. Y.; Miss K. Buckley, Brooklyn, N. Y.; Miss Stella Buckley, Brooklyn, N. Y.; F. B. Mistrosky, Detroit, Mich.; Ion Simonds, Charleston, S. C.; J. B. McCarthy, Detroit, Mich.; A. E. Braddell, Chicago, Ill.; S. C. Harvey, Chicago, Ill.

The following companies had exhibits:

Stanley & Patterson, New York city—Wireless battery holders, "Faraday" bells, etc.

Hartford Time Switch Company, Hartford, Ct.—Hartford time switches.

De Veau Telephone Manufacturing Company, New York city—Switchless telephones, etc.

Gamewell Fire Alarm Telegraph Company, New York city—Successive fire-alarm boxes, punching registers.

Duplex Metals Company, New York city—"Monnot" copper-clad steel wire.

Leeds & Northrop Company, Philadelphia, Pa.—Electrical measuring instruments.

P. R. Manufacturing Company, Detroit, Mich.—Electric bells, etc.

Frank B. Cook, Chicago, Ill.—Telephone protection apparatus.

Corwin Telephone Manufacturing Company, Chicago, Ill.—Telephone apparatus.

Gould Storage Battery Company, New York city—Storage batteries for signaling systems.

Reorganization of the Mohawk Valley Company.

The Public Service Commission, Second District, has passed upon the preliminary applications in the financial reorganization plan of the Mohawk Valley Company, the holding company of the so-called Vanderbilt or Andrews syndicate electric railroad and lighting properties.

Prior to the enactment of the Public Service Commissions law the Mohawk Valley Company could lawfully acquire and hold stock of railroad and lighting companies to an unlimited amount. Its operations have been conducted upon the assumption that this right continued in the control and management of the companies in which it owns a majority of the stock and the financing has been carried on upon this assumption.

Section 54 of the Public Service Commissions law provides that where stock shall be transferred or held for the purpose of collateral security, no stock corporation of any description, domestic or foreign, other than a railroad corporation or street railroad corporation, shall purchase or acquire, take or hold, more than ten per centum of the total capital stock issued by any railroad corporation or street railroad corporation, or any other common carrier.

Under this provision of statute the Mohawk Valley Company was required to change its method of financing, and it has been found necessary to devise other meas-

ures for the handling of its property. An extensive scheme of reorganization, which involves a series of applications to the commission, has been worked out. The plan involves a series of complicated changes in the handling of stocks and the amount thereof of the various companies concerned in the transaction.

The essential feature of the plan when it is entirely consummated is that there shall be no more securities afloat than now and that there shall have been accomplished no increased issue of stocks or bonds. The end to be attained is a change in the ownership of stocks so that the financial operations of the various companies may be placed in harmony with the existing law. The whole scheme has been informally submitted to the commission for its opinion.

The companies in which the Mohawk Valley Company is interested and its holdings are as follows:

Name of Company.	Amount Outstanding.	Mohawk Valley Amount.	Co. Owns per ct.
Utica & Mohawk Valley Railway Co.	$7,500,000	$7,500,000	100.00
Oneida Railway Co.	*1,923,000	1,923,700	99.98
Syracuse R. T. Railway Co.	†3,918,071	2,317,500	59.14
Rochester & Eastern Rapid Railway Co.	1,500,000	1,500,000	100.00
Schenectady Railway Co.	4,100,000	2,050,000	50.00
Rochester Elec. Railway Co	200,000	173,900	86.95
Rochester & Suburban Railway Co	420,000	400,800	95.42
Rochester & Sodus Bay Railway Co.	1,850,000	1,100,000	59.45
Ontario Light & Traction Co	100,000	100,000	100 00
Rochester Railway Co.	6,000,000	900	.03
Rochester Railway & Light Co.	9,498,860	7,638,900	80.41
Canandaigua Railway & Gas Light Co.	50,000	20,550	41.00
Eastern Monroe Electric Light & Gas Co.	250,000	250,000	100,00

* $77,000 owned by Oneida Railway Co.
† $81,928.26 owned by Syracuse Rapid Transit Railway Co

The net result of the changes involved is that instead of owning the surrendered capital stock of the Mohawk Valley Company the New York Central & Hudson River Railroad Company will be the owner of stocks to the amount of $10,230,480, and that instead of holding the indebtedness against the Mohawk Valley Company of $4,500,000, it would be the owner of the capital stock of the Rochester Railway Company of the par value of $2,998,700 and of the assumed value of $4,500,000. This action is approved, the commission insisting that it must, "however, be clearly understood that this action of the commission is not to be construed as an unqualified approval of the results to which it assents. The commission finds itself confronted with a situation arising out of a change of law. That change of law compels a change of corporate relations. To some change it must assent in order to preserve properties under its supervision in a condition to meet the public requirements which they were created to serve. It deems that wise policy and a just regard both for the public and private interests involved require it to authorize that course which within the law best meets the exigencies of the situation, although it might be as an original proposition disconnected from existing investments, legal at the time they were made, it would unhesitatingly stamp that course with its disapproval. The new restrictions upon corporate dealings should be applied to existing investments with sense and judgment, and that has been the endeavor in this case."

The application of the Rochester & Eastern Railway Company is for the consent of this commission to increase its capital stock from the sum of $1,500,000 to $15,290,200, thus making an increase in the amount of its common capital stock in the sum of $13,790,200.

There is nothing in the present condition of this company, if it be considered by itself, which demands for the purposes of its successful operation as a railroad that its capital stock be increased. For reasons it has been selected, however, as a company which shall become the owner and holder of certain other railroad stocks which must be placed somewhere under the proposed scheme relative to the holdings of the Mohawk Valley Company. This application is granted.

The next step is to be as follows: The consolidating company succeeding to the Rochester & Eastern Rapid Railway Company would be the owner of the total capital stock of the Oneida Railroad Company and the Utica & Mohawk Valley Railroad Company, except the amount of $300 of the Oneida Railway Company, which it is proposed to acquire. Upon the acquisition of this stock by the consolidated company, it then being the owner of the total capital stock of the two companies, it is proposed to merge the same with the consolidation, pursuant to the provisions of the statute in that behalf, and thus extinguish the two companies and reduce the number of companies to three, namely, Schenectady, Syracuse Rapid Transit and the Consolidated.

This completes the series of operations definitely projected, although it is clearly understood that these applications are granted upon the express understanding that it is contemplated by the applicants to consolidate and merge the companies, and to place a general refunding mortgage upon the property of the consolidated company, and that these applications are granted for the express purpose of bringing about the final results as indicated. "The commission grants these applications in view of all the reasons presented to it in connection with the entire series of transactions. It might hesitate seriously to grant these applications were the proceedings to stop with them and nothing further be done. It realizes that it has no powers to compel the consolidation or the merger, and that these acts will take place depends upon the good faith of the parties, which is pledged to the same, and of which pledge these remarks are to remain as the evidence." Upon the theory that this is the proper way in which to handle the financial operations of all the consolidated companies, it is believed that a better market can be found for bonds which are secured by all of the properties than for bonds which have a security upon the property of one company alone.

The opinion written by Chairman Stevens holds:

1. That the situation of all the companies involved justified and required a change in the stock holdings.

2. That the change in the law compelled a change in the corporate relations.

3. That wise policy and a just regard for both the public and private interests affected required the commission to authorize such reorganization as within the law best meets the exigencies of the situation, although the results may be such that as an original proposition disconnected from existing investments, legal at the time they were made, it would unhesitatingly stamp them with its disapproval.

4. In any inquiry into the rates and charges of a public service corporation, that portion of its capital stock issued for the purpose of owning and holding the stocks of other corporations is not a factor to be considered. Upon such an inquiry if the capital stock of the corporation is an element to be considered, only that portion of the capital stock which may be said to represent the property operated is entitled to be regarded.

5. Capital stock will not be permitted to issue for the purchase of the stock of other corporations unless the stock to be purchased has a value substantially equal to the par value of the stock to be issued. The protection of ignorant or improvident persons against stock issues representing fictitious values requires this rule.

The Character of Corporate Stocks Discussed—They are considered to be evidence of right to an aliquot part of the corporate assets upon final dissolution and division and of the right to the same part of any dividend which may be declared. The so-called par value furnishes no indication of the true value of the property to which the stocks are mere evidences of title or the dividend-earning power of the same.

THE TEST-METER METHOD OF TESTING SERVICE METERS—III.

BY JOSEPH B. BAKER.

THE MOWBRAY TEST METER, PRESENT FORM—GENERAL FEATURES.

The Mowbray test meter is now made in improved form in both direct-current and alternating-current types.[1]

The improvements consist in a refinement of the device described in the preceding article whereby the "sight method" of reading the test meter is simplified and facilitated; in better arrangements for making connections and for starting and stopping the test meter; and in superior flexibility, portability and general handiness of the test meter as a whole.

The construction and operation of this type are based on the alternative method of testing referred to in the preceding article, in which readings of a pointer and scale attached to the test meter are compared with a determined number of revolutions of the consumer's meter under test. By the simple plan of starting and stopping the test meter electrically, however, it is made practicable for a single observer to perform the tests, instead of requiring a tester and a helper as in the use of the earlier type.

Fig. 3 is a general view of the latest type of Mowbray direct-current test meter, and Fig. 4 is a diagram of the potential circuit and of the methods of making running and heating connections.

THE DIRECT-CURRENT TEST METER.

The direct-current test meter consists of a modified, inverted commutator meter having two potential circuits and a composite field-winding, and a diamond cup-jewel step bearing and sapphire ring-stone top bearing, and is mounted in a carrying case, with soft rubber cushions to absorb vibration.

Mr. Mowbray states that the composite field-winding in the present form of test meter is designed to facilitate the accurate adjustment of the ratio between the windings by arranging the individual coils so as to make energy field (as a whole) of the same mean diameter, or in other words bring the average distance of the turns in each field of the composite winding the same distance from the armature as the average distance of the turns of every other field. In the 1902 form of composite winding, in which each pair of coils constituting a field was symmetrically arranged (one on either side of the armature) with the smaller-wire coils on the outside, it was a matter of lengthy experiment to determine the right number of additional ampere-turns to add to the outside coils in order to compensate for

FIG. 3.—LATEST TYPE OF MOWBRAY DIRECT-CURRENT TEST METER.

the greater mean distance of this coil from the armature. In the present form the mean diameter of the two coils constituting each field is made equal to the mean diameter of the entire composite winding, by making one of the two coils

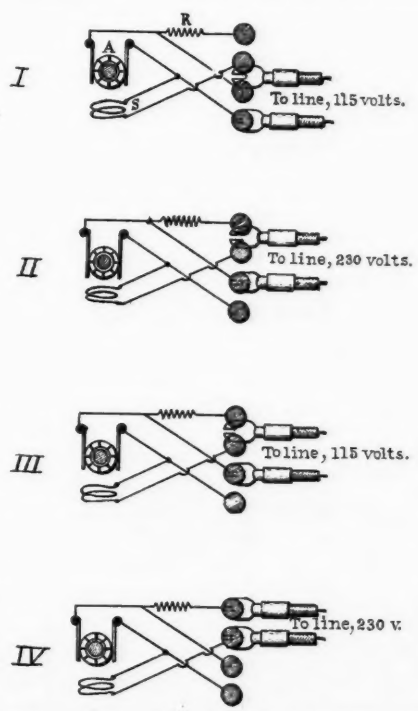


FIG. 4.—DIAGRAM OF POTENTIAL CIRCUIT AND METHOD OF MAKING RUNNING AND HEATING CONNECTION.

smaller in diameter and the other an equal amount larger in diameter, than this mean. Thus, in a composite winding consisting of one-ampere, four-ampere, sixteen-ampere and eighty-ampere fields, the group of coils on one side of the armature would consist of an eighty-ampere coil (innermost) having a sixteen-ampere coil wound over it, then a four-ampere coil, and lastly (outside of these three) a one-ampere coil; whereas the group of coils on the other side of the armature, in order from innermost to outermost, would consist of one-ampere, four-ampere, sixteen-ampere and eighty-ampere coils.

Another feature of the present composite field-winding is that the available wire is used to best advantage by including the coarser coils in circuit with the finer ones in progressing from the highest-value field to the lowest. Thus, in the four-field test meter referred to the eighty-ampere field consists of the one pair of eighty-ampere coils already described, *viz.*, the innermost coil of the group on one side of the armature and the outermost coil of the group on the other side; but the sixteen-ampere field would include not only the pair of sixteen-ampere coils but also (in series therewith) the pair of eighty-ampere coils; the four-ampere field would comprise the four-ampere, sixteen-ampere and eighty-ampere coils, and the one-ampere field the one-ampere, four-ampere, sixteen-ampere and eighty-ampere coils.

The preceding arrangement, which obviously occupies the minimum amount of space for a given field strength, superseded a bulkier and more complicated form of composite field-winding comprising eighty-ampere, twenty-ampere, four-ampere and one-ampere "scales" in which a commutating switch, mounted on an insulating drum and operated by a knurled knob, was used to make the different combinations. The test meter illustrated in Fig. 5 and Fig. 6 is equipped with this arrangement and also with the telephone device described in the preceding article. The eighty-ampere scale was cut in, on this switch, by connecting four twenty-ampere coils in parallel, and the twenty-ampere scale by connecting these coils in series; and the four-ampere scale was cut in by connecting four one-ampere coils in parallel, and the one-ampere scale by connecting these one-ampere coils in series.

In some of the Mowbray test meters a brass upper bearing was used. The bearing hole was countersunk at the lower end of the bearing plug, to prevent the shoulder of the meter shaft from battering the plug—as by the up-and-down motion of the rotating element in carrying the test meter in an inverted position (see Fig. 2[1])—in such a way as to cause binding on the shaft. Modern test meters of the type exemplified in Fig. 3 and Fig. 6 are carried right side up and have a "locking device" for keeping the rotating element out of contact with the jewel in transportation.

The case is provided with a hard rubber top on which are mounted binding-post terminals of the various field and potential windings to facilitate making the various warming-up and running connections, to-

[1] The alternating-current test meter illustrated herewith is designed with 1.5, fifteen and 150-ampere current coils, for 115 and 230 volts, sixty cycles. The direct-current test meter illustrated is designed with one, four, sixteen and eighty-ampere current coils, for 115 and 230 volts. Alternating-current and direct-current test meters of just one-half the above current capacities are also made; also a direct-current meter with one, three, ten and thirty-ampere coils.

[1] Page 236, Vol. 53, No. 7.

gether with a pair of knurled heads for adjusting the friction-compensating coil without removing the meter from the case, and a small level. The usual meter register is omitted and a horizontal "dial," which is observed through a window in the hard-rubber top, is provided instead. The dial consists of a large circular scale, divided into 100 scale divisions, swept by a pointer fixed to the upper end of the meter shaft, and a smaller circular scale having ten scale divisions and with a pointer geared to the shaft in the ratio of 10 to 1, so that for every revolution of the pointer on the large scale the pointer on the small scale moves through one scale division.[1] In the lower part of the case is located a small window for observing the condition of the commutator. In the form illustrated the meter itself is not equipped with a switch for starting and stopping, this switch being inserted in the current leads.

This direct-current test meter is claimed to possess an exceedingly high torque—about double that of an ordinary small consumer's meter—secured by increasing the number of turns in both the field and armature windings, and by omitting from the 115-volt potential circuit the usual series resistance and applying the total voltage direct to the armature and friction compensating coil in series.

THE ALTERNATING-CURRENT TEST METER.

A recent type of alternating-current test meter consists of a modified induction meter mounted in a carrying case and equipped with many of the general features of the direct-current test meter. In the hard-rubber top are current and potential binding-posts, a single knurled switch for adapting the potential circuit for 115 to 230 volts, a small level, a push-button switch for starting and stopping the meter by closing and opening the potential circuit, and the window for observing the dial.

Testing with the present form of test meter, of either the direct-current or alternating-current type, requires only one man, because the test meter, which is used after the manner of a stop-watch, constitutes the only piece of test apparatus used. The starting and stopping, however, are not accomplished mechanically, as in a stop-watch, but electrically by means of the switch, which throws the test meter in or out of circuit. After making the necessary connections to the service wires at the consumer's meter the test meter is simply switched into circuit during the time required by the consumer's meter to make a determined number of revolutions, noted in the usual way by observing a mark on the disc, and out of circuit again at the end of this interval. The switching is effected in the direct-current type

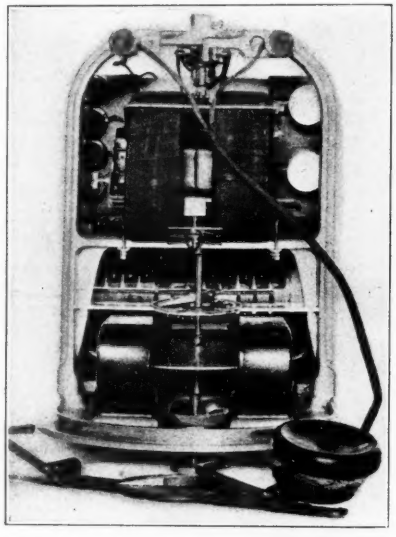


FIG. 5.—MOWBRAY ALTERNATING-CURRENT TEST METER.

by cutting in the series fields on the load, and in the alternating-current type by closing the potential circuit across the voltage. Obviously no appreciable net error is introduced by this start-and-stop method of comparing the test meter with

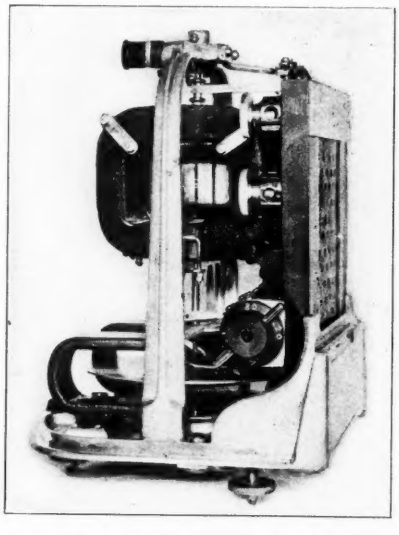


FIG. 6.—MOWBRAY ALTERNATING-CURRENT TEST METER.

the consumer's meter, as the lag of the disc in starting, due to its inertia, when the test-meter switch is thrown on is compensated for by the overrunning of the disc, restrained by the braking magnets, after the switch is thrown off.

In the direct-current test meter, normal running temperature (and consequent accuracy) is reached by the application of double voltage to the test-meter potential circuits in series, or of normal voltage to the potential circuits in parallel, for a period of two and one-half minutes. This increased time, as compared with the one and one-half minutes required for the armature of the first model to heat, is due to the fact that the new model armature is specially wound with a much greater number of turns. In the diagram of Fig. 4, I shows the connections for heating the 115-volt circuit in two and one-half minutes on 115 volts; II, the connections for heating the 115-volt circuit in two and one-half minutes on 230 volts; III, the 115-volt running connections, and IV, the 230-volt running connections. Normal voltage is then applied and the potential circuit is allowed to remain undisturbed until the completion of the test, as any interruption of this circuit would allow it to cool down and render the test meter for the time inaccurate. For this reason the operating switch of the direct-current test meter is, as already stated, located in the *current* circuit (see Fig. 3). The operating switch is constructed so as to cut the field windings in and out without at any time opening the main circuit or causing arcing.

In the alternating-current test meter the operating switch is, as already stated, in the *potential* circuit. The fact that voltage is not applied all of the time causes no inaccuracy because, as in ordinary induction meters, the temperature and resistance, and hence the accuracy, vary but slightly with respect to the length of time that the voltage is applied.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on September 1 for two sets of wireless telephones for delivery at Brooklyn, N. Y.; for miscellaneous rubber-insulated cable for delivery at Washington, D. C.; for 6,450 feet of telephone cable for delivery at Boston, Mass. On September 8, for 100,000 feet of ship lighting cable, for delivery at Brooklyn, N. Y.; for miscellaneous electrical supplies for delivery at Boston, Mass. On September 15, for 800 feet of rubber-insulated cable, 6,600 conduit clamps and six transformers for delivery at Mare Island, Cal.

[1] See also paper entitled "A New Rotative Test Meter," by W. J. Mowbray, read before the Association of Edison Illuminating Companies at the Lake Champlain convention, September 12-14, 1905.

RAIL CORRUGATION.[1]

BY PROFESSOR C. A. CARUS-WILSON.

It will not be necessary for me to spend time in giving any general account of rail corrugation; the phenomenon is, unfortunately, only too well known to all those interested in tramways. I will therefore begin by asking you to consider certain facts which may throw light on the vexed question as to how corrugations are formed.

You have no doubt observed that corrugations on grooved rails are very often accompanied by a cutting of the check of the rail immediately opposite. This is

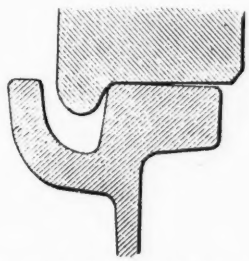


FIG. 1.—NEW WHEELS AND RAILS.

especially noticeable on curves, where the centrifugal force has made the inner flange bear against the inner check, the corrugations being on the outer rail. But the same kind of check-cutting is found on the straight, where the car has been bearing over on one side or the other, the corrugations appearing on the rail immediately opposite the one whose check is cut. Speaking generally, it may be said that, with some exceptions, to which I will allude later on, corrugation is accompanied by a cutting of the check of the opposite rail.

When wheels and rails are new there is a clearance, generally of about one-quarter inch, between the flange and the check on both sides, as shown in Fig. 1, which represents the normal position of the flange in the groove on each side when new. Any side pressure on straight or curve is then taken by the throat of the flange bearing on the head of the rail. The flange can not come in contact with the check until considerable wear has taken place. Fig. 2, taken from a cast of an actual tire, shows how the flange bears against the check when the flange has worn sufficiently. Such instances of check-cut tires are very common.

I do not now propose to pursue the important inquiry as to how this wear is brought about, as this would involve a discussion of the whole problem of wheel wear; but, taking the fact that check-cutting generally accompanies corrugation, to consider the question as to the possible connection between the two. The answer to this question depends upon the solution of a very much wider question, *viz.*, when a wheel rolls upon a flange how is the motion affected by the grinding of the flange against the head of the rail? With a view to investigating this matter I have constructed a model which consists of a four-wheel truck with brass wheels two and one-half inches diameter, whose centres are four and one-quarter inches apart. There is an equalizer suspension by which a weight, hung from a

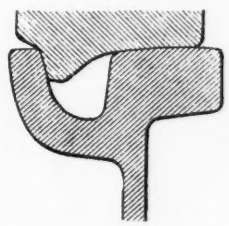


FIG. 2.—SHOWING WORN FLANGE BEARING AGAINST CHECK.

central support, is distributed equally over the four wheels. One wheel on each axle is keyed to the shaft, the other being a loose wheel held in place by a sleeve. The left of these loose wheels has its sleeve slotted to correspond with a slot in the end of the axle; into this slot can be placed a plate or coupler which at the same time fits into a stud in the rim of the wheel. When the coupler is fixed in position the wheel is thus coupled to the axle. Different couplers may be used, some being rigid and some of the nature of a stiff spring. There is a mark on the rim of the coupled wheel which may be set opposite to any required point on the rail. The track consists of brass rails, three-sixteenths inch wide and three feet long, set to a gauge of three and nine-sixteenths inches, with a space between them to admit of the passage of the suspension for the weight.

The truck is first loaded with a weight of fourteen pounds, a rigid coupler inserted in the loose wheel, and the mark set opposite a point A at the right-hand end of the track. The truck is then gently pushed from behind and made to travel over the track until the wheel has made three complete revolutions and the mark has met the rail at a point B. The distance AB then represents a pure roll equal to three times the circumference of the wheel. The truck is taken back and the mark placed opposite point A as before. If the flange of the coupled wheel is now pressed hard against the rail while the truck is made to travel forward, it is found that the mark will meet the rail at a point C which lies beyond point B, the distance BC being about two per cent of AC. Owing to the side pressure the flange bites the rail on a line of contact whose diameter is greater than that of the tread of the wheel; the wheel tends to run on this line of contact, and the tread is forced to skid on the head of the rail in consequence. The result is that the motion is a combined roll and skid, the distance AB representing roll and BC representing skid. The skidding, however, is continuous, and for any part of AC covered, say the hundredth of an inch, the same proportion, *viz.*, two per cent, is skid. The two wheels, being rigid on one side, both skid an equal amount.

It thus appears that when the flange is forced against the side of the rail the wheels are made to skid a certain percentage of the distance traveled. Having ascertained this fact, the next step was to find out whether any such skidding took place on an actual tramway track. For this purpose I conducted a series of tests at Croydon on a car placed at my disposal by T. B. Goodyer, general manager of the Croydon Corporation Tramways.

The car selected for the tests was a four-wheel double-deck car with Mountain & Gibson truck equipped with two Westinghouse No. 200 motors, weighing, with five passengers, 7.8 tons. The truck had a wheel base of six feet, with British Griffin chilled-iron wheels. A bicycle gear-wheel with sixty-eight teeth was fixed on one of the axles and connected by a chain-drive to a spur-wheel with fourteen teeth secured on the floor of the car. A Harding speed counter was attached to the spur-wheel, by which the revolutions of the axle could be measured. The circumference of each wheel on this axle was measured with a steel tape, and checked by calipering, the result being exactly ninety-five and three-quarters inches in each case, the two wheels having the same diameter.

A section of straight and nearly level track was chosen on the road between Croydon and Purley. There are here two lines of rails, badly corrugated for the greater part of the distance. The track is of standard gauge with macadam sides, and the rails, weighing ninety-five pounds per yard, are laid on a six-inch bed of concrete. Two trolley poles, about half

[1] Lecture delivered before the Tramway Congress at the Franco-British Exhibition, July 10, 1908.

a mile apart, were selected, and the distance between them chained and found to be 2,597 feet. If this distance were covered by simple rolling the counter would make 1,581 revolutions. The method of test was as follows: One observer was told off to take charge of the counter, a second to take the time and a third to call the start and the stop. The car was started up some distance behind the first pole, which it passed at full speed; at the moment of passing the third observer gave a signal; the time was taken and the counter inserted in the spur-wheel. The car covered the distance at constant speed without slowing down; on passing the second pole, at a given signal the time was taken and the counter withdrawn. The car was then brought to rest beyond the second pole and was changed over to the up track, when the same process was repeated in the reverse direction. The slight difference of level resulted in the up journey being made at a rather higher speed than the down journey. Two trips were made each way with the track very dry, and two trips each way after a heavy rainstorm, the track being then very wet, but not greasy. The results are given in the following table:

	Condition of Track.	Mean Counter Revolutions.	Skid in Counter Revolutions.	Skid in per Cent of Distance Covered.	Mean Speed Miles per Hour.
Down trip	Dry.	1,516	65	4.1	11.2
Down trip	Wet.	1,535	46	2.9	11 1
Up trip...	Dry.	1,522	59	3.7	14.4
Up trip...	Wet.	1,547	34	2.1	14.0

From these experiments it appeared that when a car travels along a tramway track the wheels skid upon the head of the rails in the same way as they do in the model.

It remained to be seen in what way the skidding, which had been shown to take place, could produce corrugation. For this purpose further experiments were made on the model. In order to get a definite amount of skid that should be independent of possible variations in the side pressure exerted, a metal fillet was inserted against one of the rails in such a way as to lift the keyed wheels off the rail and force them to roll on the outside of their flanges. The diameter of the outside of the flange is about nine per cent greater than that of the tread, and a pure roll on the flange would correspond with the distance AD on the rail, where BD is about nine per cent of AB, which represents three complete revolutions on the tread.

If the loose wheel is now fitted with a rigid coupler, the motion of the coupled wheel will be a roll and a skid, and of the keyed wheel a roll and a slip, the proportion of skid to slip depending upon the relative coefficients of friction, but the sum of the two always being equal to BD, or nine per cent of AB. With a total weight of forty-two pounds—that is, 10.5 pounds on each wheel, the coupled wheel skids about eight per cent. The skidding remains quite uniform and continuous as before.

If the coupler is removed from the notch and placed on one side of the stud, the loose wheel is at liberty to roll freely on the rail, and the coupler tends to draw away from the stud under the action of a definite force. This force can be made apparent if the rigid coupler is replaced by a spring coupler fixed in the notch. Whichever way the truck is pushed the spring is bent, indicating a tendency to twist the coupled wheel relatively to the axle. The angle through which the spring is bent represents the torsion required to overcome the adhesion between the tread of the wheel and the rail.

From these experiments it is evident that when the flange of a car wheel grinds against the rail in such a way as to cause skidding, the axle will be twisted until the torsion is sufficient to make the tread of the mate wheel skid on the rail, the elastic twist of the axle representing the bending of the spring in the model.

So far, however, the skidding is quite continuous, and there is no indication of any intermittent action such as could produce corrugation. But the experiments with the model have been carried out under conditions differing in one very important respect from those of actual practice: the rails have been quite clean. It remains to be seen what is the effect of making the rail surface rough, as it is in practice. For this purpose a little sand may be sprinkled over the surface of the rail. If the truck is now pushed along the track, an entirely new effect is produced: the coupled wheel, instead of moving uniformly as before, now advances with a series of jerks at regular intervals.

The action is as follows: When the torque on the spring has increased to a certain amount, the force of adhesion is overcome, and the wheel skids, turning meanwhile about its own axis, so that the whole force of the skid is concentrated over a limited area on the rail surface. In skidding the wheel grinds through the grit on the surface of the rail and comes into contact with clean metal; there is thus a large and sudden reduction in the coefficient of friction, and the wheel flies back under the influence of the spring through a considerable angle. The result is that the subsequent motion of the wheel upon the rail will be a pure roll while the spring is being again deflected. When the limit of adhesion is reached, the wheel again skids, and the process is repeated, the motion thus consisting of alternate rolling and skidding. The addition of the grit has made the skid intermittent, whereas formerly it was continuous. When the surface of the rail is clean, there is no sudden breaking down of the adhesion which is required to make the skid intermittent. This effect is not due to the increased torsion on the spring consequent on the increase in the coefficient of friction; for the same torsion can be obtained with a clean rail by increasing the weight, when the skid remains continuous.

So long as the rail is clean, the motion is thus continuous and uniform. In order to produce intermittent action it is essential that the rail surface should have been roughened by the application of some hard and gritty material. In tramway practice such material is furnished by dust, and especially by the sand which is put on the rails. According to my observations the presence of sharp grit on the rail surface is a prime factor in the production of corrugation. Numerous instances might be quoted where corrugations are worst in places where the rails are liable to be continually covered with sharp, gritty dust. Thus, in the case of the Brussels tramways, the worst corrugated section in the whole city is on the Boulevard de Waterloo, where the tram lines are flanked from end to end by a sand-covered avenue. This may also explain why the tram lines in one town—say, for example, Norwich—are badly corrugated, while at another — say, Coventry—where the track, the rails and the rolling stock are identical in character, there is little or no corrugation, the difference being due to the quantity of dry flint-dust that is blown over the Norwich tracks by the prevailing east winds.

The experiments on the model afford an explanation of the connection between check-cutting and corrugation. The flange of one of the two wheels on an axle grinds against the rail on a line of contact having a diameter greater than that of the tread, causing both wheels to skid. The skidding on the one side, where the flange is grinding, will be uniform, but on the other side, owing to the twist of the axle, the skidding will be

intermittent, provided the rail surface be sufficiently rough, and the motion will be an alternate rolling and skidding. This explains why, as a rule, corrugations appear on one rail only: both wheels are skidding, but, owing to the twist of the axle, one skids uniformly and the other intermittently, the intermittent skidding taking place on the rail opposite to that where the flange is grinding. Observation shows that the rail opposite the corrugated rail is generally scored uniformly, though often with a slight wavy appearance which is caused by the sudden release of the twist on the axle affecting the motion of the non-corrugating wheel.

The distance apart of the marks on the rail, or the pitch of the corrugations, necessarily depends on the action above described. When the coefficient of adhesion, the weight on the wheel and the dimensions of the axle are fixed, the limiting amount of twist measured, say, in fractions of an inch at the rim of the wheel, is also fixed. Now the skid is a definite per cent of the distance traveled, say, x per cent, and when corrugation takes place the skid between any two marks is accumulated in the twist of the axle, hence x per cent of the pitch must equal the limiting twist on the axle. Thus if the skid is two per cent and the limiting twist 0.02 inch, the pitch would have to be one inch. It is necessary, therefore, to ascertain whether this relation holds good in practice.

With the car used in the Croydon tests the weight on each wheel was 4,370 pounds, the diameter of the axle three and three-quarters inches, and the distance between wheel hubs forty-eight inches. Taking the modulus of transverse elasticity for the axle at 14×10^6, and the coefficient of friction at 0.4*, the twist measured at the rim of a wheel thirty-one inches in diameter will be 0.073 inch. For a skid of three per cent the pitch of the corrugations would therefore have to be 2.4 inches. On the Croydon tramways the pitch of the corrugations on the straight varies from two and one-quarter inches to two and three-quarters inches.

During the process of corrugation the axle is subject to torsional vibration, and in order that the skidding may continue to take place intermittently the twisting force must be applied rhythmically with a time interval equal to the period of vibration of the axle. Hence the time occupied in covering the distance between two successive skids will be a constant quantity for any given wheels and axle. It follows, therefore, that the pitch of the corrugations will depend not only upon the skid, but also upon the speed of the car. Thus, if the mean speed is twelve miles an hour for corrugations having a pitch of two and one-half inches, when the speed is twenty-four miles an hour, the pitch would be five inches. This increase of pitch with speed has been noticed by many observers.

It would seem, then, that the pitch is determined, in the first place, by its relation to the per cent skid and the limiting twist on the axle, and in the second place by the speed, and that corrugation can not take place unless the two sets of conditions are to some extent in agreement. Thus in the case just quoted the skid at twenty-four miles an hour must be half that at twelve miles an hour; that is, if the skid is halved the speed must be doubled.

This may explain why on tramways in this country corrugations rarely appear unless accompanied by check-cutting on the opposite rail. Until such check-cutting takes place the side pressure is taken by the throat of the flange bearing against the head of the rail, the line of contact being only slightly below the tread of the wheel. Under these conditions the skid is small—not exceeding one or one and one-half per cent. Taking the relation of pitch to skid as calculated for the Croydon car, this amount of skid would correspond with corrugations having a pitch of from five inches to seven inches, involving a speed of from twenty-four to thirty-six miles an hour, or two to three times our normal speed. Hence the speeds on tramways in this country are too low to give corrugations except where the skid is large, as happens when there is check-cutting. Similar conditions obtain more or less on the Continent.

Where the speeds are higher, as on American tramways and on steam railways, corrugations may, and do, appear with the small per cent of skidding that is caused by the ordinary side pressure of the flange on the rail.

The side pressure of the flange on the rail that is necessary for the production of corrugations is caused, on the straight, by irregularities of gauge and level, which make the car lunge from side to side and bear over against one rail or the other. This accounts for the irregular distribution of corrugations along the track, first on one side, then on the other, in long or short stretches, with smooth parts in between. The tendency of a car to lunge from side to side in the manner described neutralizes the tendency of the car to ride down on the lower side on a double track, in spite of the usual camber, and corrugations are found quite as frequently on the inside as on the outside rail on a double track on the straight. The irregularities of gauge and level, due in the first instance to faulty construction, are augmented by the wear and vibration to which the track is subjected. This is one reason why corrugations generally take time to develop.

On a curve there is always a definite force, due to centrifugal action, tending to press the flanges outward. If the curve is of large radius the speed will be practically the same as on the straight, and the conditions under which corrugations may be produced will be similar, except that the pressure is constant and always in one direction. When flanges and rails are new the pressure is between the outer flange and the outer rail, but the skidding thus caused is small, and not enough to produce corrugations at ordinary speeds. After sufficient wear has taken place to bring the inside flange against the check of the inner rail, corrugation will begin on the outer rail. For this reason, on any tramway system, corrugation will generally first begin on large radius curves, corrugations appearing on the outer rail accompanied by cutting of the check of the inner rail.

The difference of length between the inner and the outer rail on a curve gives rise to a skidding or slipping quite apart from that due to the grinding of the flange on the rail. With curves of large radius this difference is small, and does not greatly affect the conditions of corrugation. With curves of small radius the difference produces a skidding or slipping which is large compared with that produced by flange grinding, and the conditions of corrugation become very complex. Speaking generally, however, it may be said that the speeds on small-radius curves are, as a rule, too low to admit of corrugations being formed.

The pitch of the corrugations on a curve is generally less than on the straight. Thus in the case of a car which produces corrugations on the straight having a pitch of 2.4 inches with three per cent skid, on a curve of 500-foot radius

*The most complete tests made to determine the coefficient of adhesion for a wheel on a rail under varying conditions are those made by Captain Galton, and published in the Proceedings of the Institution of Mechanical Engineers, 1878-9. The results there recorded indicate that the limiting or static coefficient of adhesion, immediately previous to skidding, exceeded 0.38 for a clean dry rail, and rose still higher on the application of sand. The value 0.4 is here taken as the limiting coefficient of adhesion.

the skid on the outer rail due to the difference in the length of the inner and outer rails will be about 0.9 per cent, making a total of 3.9 per cent. Now the pitch is inversely proportional to the per cent skid, so that the pitch of the corrugations on the curve should be about 1.9 inches. Observation shows that the pitch on curves is reduced about in this proportion.

The appearance of corrugations on the grooveless girder-rail used in Philadelphia and other American cities presents some interesting features in connection with what has been said as to side-flange pressure. A full report on this subject was presented by H. B. Nichols, engineer to the Philadelphia Rapid Transit Company, at the 1907 convention of the American Street Railway Engineering Association. (See Tramways and Light Railways Association circular for April, 1907.) A section of the rail and tire used in Philadelphia is reproduced in Fig. 3. The rail shown is a ninety-three-pound girder-rail, eight and three-quarters inches deep with a three-eighths-inch web. Careful observation showed that when the normal traffic was passing over this rail at a point on the straight where corrugations had appeared, the head of the rail was forced outward, due to a bending of the web, by as much as three-thirty-seconds inch. The web was then stiffened by the addition of fishplates, after which the corrugations disappeared. Subsequently this rail was replaced by another rail weighing 137 pounds, with a one-half-inch web, after which corrugations appeared only in a few places. Finally this rail was replaced by a rail weighing 141 pounds, with a nine-sixteenths-inch web, after which there was no trouble from corrugations.

It has been suggested that the corrugations in this case were due to vibrations in the rail, which were stopped by the stiffening of the web; but I would submit the following as a more probable explanation. A side deflection of three-thirty-seconds inch corresponds to vertical depression of 0.03 inch at the outside of the tread of the wheel—that is to say, the side pressure caused by the lunging of the car lifted the wheel off its tread, and threw almost the whole weight on the throat of the flange, causing the wheel to ride on a line of contact about one-quarter inch below the head of the rail—that is, on a diameter about one and one-half per cent greater than that of the tread—thus producing corrugations in accordance with the principles already stated. A simple calculation will show that when the web has been thickened to nine-sixteenths inch the lift off the tread for an equal side pressure has been reduced to 0.009 inch, and the tendency of the wheel to ride on a larger diameter than the tread has been practically eliminated.

Although corrugations are, in my opinion, generally caused by the grinding of the flange on the rail, this is not the only way in which they may be produced. A similar action may be set up if for any reason the wheel should be forced to run on its flange. This often happens at points and crossings, the tread of the rail being lifted clear off the rail-head, when corrugations may frequently be observed on the opposite rail. The same thing happens when the rail has been badly worn and the flange actually touches the bottom of the groove.

The most common example of flange riding, however, is found where the groove is allowed to get full of dirt. I have seen places where the groove has been packed with a mixture of dirt, wood-pavement

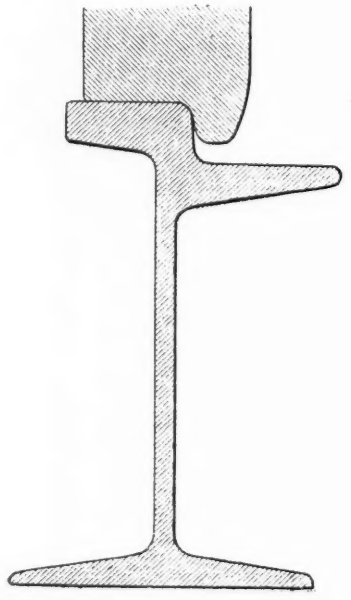


FIG. 3.—SECTION OF PHILADELPHIA RAIL.

scrapings, paper, etc., so hard as to resist any attempts to move it with a metal-tipped stick. The flange runs on this packing, and if the other groove does not happen to be packed so full, corrugations will appear on the opposite rail. In the course of a few days the first groove may get cleaned out and the other groove may get packed, when the conditions will be reversed, and corrugations will then appear on the previously uncorrugated rail. In this way both rails become corrugated. Flange riding on a packed groove is responsible for some of the most perplexing vagaries of corrugation. The hardness of the packing depends very largely on the condition of the weather. Corrugations may be very pronounced in a certain place owing to a packed groove. A few days' rain will soften the packing and remove the cause of the corrugations, which will then get worn down and disappear, only to reappear again, perhaps on the other filled.

The corrugations which have appeared on certain steam railways in India illustrate the conclusions arrived at above as to the conditions under which corrugations are produced. For more than ten years past corrugations have been noticed on some Indian railways, especially on the Eastern Bengal State Railway, a full account of which may be found in a paper written by G. Moyle, published in the official circular of the Tramways and Light Railways Association for June, 1906. Investigations of an exhaustive character were carried out with a view to ascertaining the cause of these corrugations. The following definite conclusions were arrived at: (1) The track on which the corrugations appeared was invariably found to be boxed with burnt clay or brick. (2) Corrugations were hardly ever found with stone boxing and never with earth boxing. (3) When the brick boxing was replaced by earth or stone boxing the corrugations disappeared. (4) To get this result it was necessary to change the boxing only, and not to remove the brick ballast packing under the sleepers. (5) Corrugated rails removed and replaced on an earth-boxed section would wear smooth, while smooth rails taken up and set down on a brick-boxed section would become corrugated.

A careful study of Mr. Moyle's paper, and the conclusions there stated, convinced me that the corrugations were in some way caused by the gritty dust that would work up from the brick boxing and be scattered over the surface of the rail by the air suction of passing trains. A possible objection to this view might be found in the fact that corrugations had appeared on open-girder bridges, where, of course, there was no brick boxing. But the objection might turn out to be a confirmation if it could be shown that the approaches to these bridges were brick-boxed, for in that case the brick dust could be carried on to the bridge by the suction of the train. Upon inquiry I was informed that investigation showed that

corrugation only developed on open-girder bridges the approaches to which were brick-boxed, thus confirming the suspicion that the corrugations were in some way caused by the dust from the brick boxing.

It remained to be ascertained in what way this dust could be essential to the production of corrugations. The subsequent experiments on the model, already described, showing how intermittent skidding is brought about by covering the rail with a gritty powder, seemed to afford the required solution. Through the kindness of Sir Alexander Rendel and F. E. Robertson I was supplied with a sample of the brick boxing taken from a section of the Eastern Bengal State Railway, where corrugations are very pronounced. Some of the brick was crushed, making an exceedingly sharp and gritty powder. The model was arranged as before with a spring coupler in the loose wheel. So long as the rail remained clean the skidding was quite uniform as the truck was pushed along the track. When a little of the brick powder was scattered over the rail the skidding immediately became intermittent, indicating clearly the part played by the brick boxing in the formation of corrugations.

The investigations outlined above appear to show that the following conditions are necessary for the formation of corrugations on grooved rails:

(1) As regards the track:

(*a*) Irregularities in gauge or level,

or

(*b*) Curvature,

or

(*c*) A packed groove.

(2) As regards the rails:

(*d*) Surface rough with sand or gritty dust.

(3) As regards the rolling stock:

(*e*) Wheels with check-cutting flanges.

(4) As regards traffic:

(*f*) A critical speed.

Corrugations can not be formed unless conditions (1), (2), (3) and (4) are all present at the same time—that is, peculiar conditions must exist simultaneously in the track, the rails, the rolling stock and the speed, and the absence of any one of these conditions will prevent corrugations being formed. These considerations suggest the lines on which it may be possible to avoid the formation of corrugations. My object this morning, however, is simply to put before you the conditions under which corrugations are produced, in the belief that a correct diagnosis of the disease is the first step to be taken toward providing a remedy.

Legality of Public Service Commission Questioned.

An order has been issued on Mayor McClellan, Comptroller Metz and the Public Service Commission directing them all to appear in court. This order, which has been promulgated by Adolph Gutner through an attorney, is a notice that a motion will be made before Justice Bischoff in Part II of the Supreme Court on August 31 why an injunction should not be granted pending the determination of the suit. The injunction is sought to prevent the further payment from the city treasury of the expenses of the Public Service Commission of the first district.

The plaintiff and his attorney, Mr. Leary, propose to put Governor Hughes's Public Service Commissions to the test of a judicial scrutiny, and Mr. Leary thinks he has an unanswerable argument against the constitutionality of one of the chief sections of Chapter 429, Laws of 1907, which act establishes the Public Service Commissions and prescribes their powers and duties and provides, through them, for the regulation and control of the public service corporations. He attacks the provision in the act that makes an appropriation for the expenses and salaries.

Lawyer Leary's principal claim against the constitutionality of the act providing for the two commissions is that it makes obligatory upon the city the payment of the expenses of a purely state and not a local official body. Granting that the two commissions are composed of state officers he asserts that the imposition upon the city of New York of several hundred thousand dollars each year of expenses for one of them is clearly unconstitutional; that the city can incur no indebtedness except for city purposes. Lawyer Leary proposes to get the courts to stop Comptroller Metz from paying any more of the expense bills of the commissioners who have to do entirely with the first district. His attack upon the second district commission is based upon other grounds.

In Section 14 of Chapter 429, Laws of 1907, relating to the payment of the commissions' salaries and expenses, Lawyer Leary points out that the salaries of the commissioners, the counsel and secretary shall be audited and allowed by the state comptroller and paid monthly by the state treasurer. The commissioners were appointed by Governor Hughes and they have control over state corporations; the city officials have no power over them or their expenses and the Appellate Division of the Supreme Court, another state institution, orders the bills paid. All this, Lawyer Leary insists, makes the commission a state board.

In his complaint the plaintiff asserts that the board of estimate has appropriated large sums of money belonging to the city on the requisition of the commission, and that the payment of this money is an illegal act on the part of the city officials. He asks that the city chamberlain and comptroller be stopped from making the payments, as the plaintiff "is advised and he is informed, and believes that the said act, Chapter 429, Laws of 1907, is wholly unconstitutional and void; and in particular the aforesaid Section 14 of said act, in so far as it attempts to impose upon the city of New York the payment of the expenses of said Public Service Commissions."

Fatal Shock from Portable Electric Lamp.

At Pinxton, England, an inquest was held on the body of William E. Phillips, a young man who was killed in the locomotive shed adjoining No. 1 pit of the Pinxton Collieries, Limited, several weeks ago, it is alleged by shock from a portable electric lamp. The evidence of Joseph Surgey, a locomotive driver, was to the effect that Surgey and the deceased were working together. Surgey left the shed, and in his absence the deceased picked up a portable lamp which was attached to an electric cable. He cried out, and when the witness went to his assistance he was found to be dead. Fred Smith, of the Langton Colliery, the electrician for the owners, said he found the porcelain inside the lamp broken, and the lamp partly unscrewed.

Cleveland Municipal Traction Makes Better Showing.

According to figures given out by the Municipal Traction Company, Cleveland, three-cent fares made a profit of $19,686 for the company during the month of July. This is the first statement which has not shown a deficit. For May, the first month the street railways were operated at three-cent fares, a loss of $54,916 was reported. During that month the motormen and conductors were on a strike. For June the loss was given at $23,829. The gross earnings for July were $437,174.

A New Type of Switchboard for the United States Reclamation Service—Salt River Project.

The Salt River project of the United States Reclamation Service is more or less familiar to a great many individuals on account of the wide advertising it has received, due to the immense size of the dam and storage basin, the latter being the largest artificial reservoir in the world; and also because the large town of Roosevelt will be wiped out of existence when the reservoir is filled. About 200,000 acres of arid land near Phœnix, Ariz., is to be irrigated by a canal system fed from the main reservoir, and it is intended to irrigate an additional 40,000 acres by underground waters, made available by the installation of pumping stations at suitable points. Two important features of the Salt River project are a 6,000-kilowatt hydroelectric power station and a 45,000-volt transmission system.

The primary object of the generating station referred to above is to provide power for the operation of these pumping plants, and it is expected that several other generating stations will be constructed at various points to provide still more power. A market for surplus power can easily be found in the towns in the Salt River Valley. A temporary plant has been in operation for some years at the Roosevelt dam to supply power for the operation of the cement mill, construction machinery, lighting of the town, etc., and some of the machines in this station are to be transferred to the new power plant. The purpose of this article is to describe the controlling board which has recently been completed for installation in the new power station.

The alternating-current switchboard selected by the Government engineers for controlling the apparatus in the main station is an excellent illustration of recent "bench" control-board construction. It is of the open type, that is, there is a space left between the instrument sections and the control bench, so that the switchboard operator can have an unobstructed view of any part of the generator room without going to the end of the board, which is located at the edge of the gallery about eighteen feet above the main floor. This benchboard is equipped for the control of the following circuits, the exciter switchboard being entirely independent and of the ordinary vertical construction.

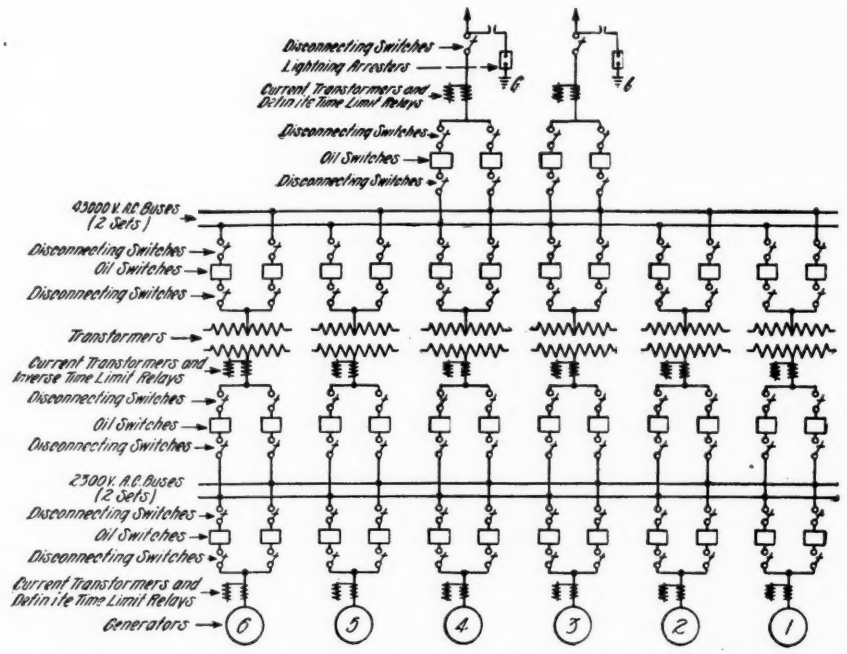


FIG. 1.—SYSTEM OF CONNECTIONS, SWITCHBOARD FOR THE SALT RIVER PROJECT OF THE UNITED STATES RECLAMATION SERVICE.

Six 2,300-volt, 1,060-kilovolt-ampere, twenty-five-cycle, three-phase, three-wire generators.

Six 2,300-volt delta, 45,000-volt Y,

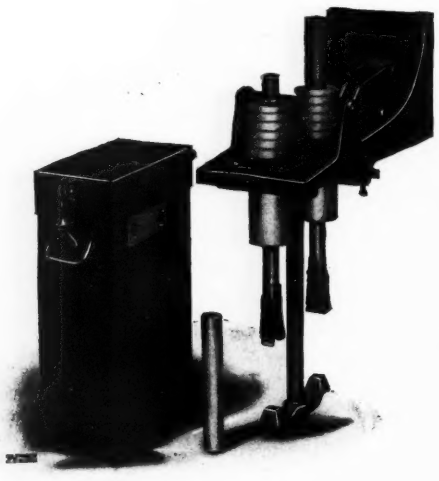


FIG. 2.—300-AMPERE, 15,000-VOLT OIL SWITCH.

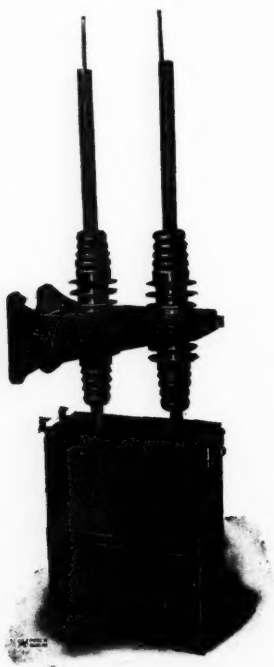


FIG. 3.—100-AMPERE, 45,000-VOLT OIL SWITCH.

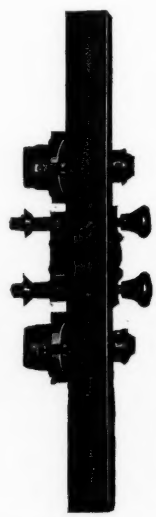


FIG. 4. — TWIN PULL-BUTTON CONTROLLING SWITCH FOR OIL-SWITCH OR SOLENOID CONTROL CIRCUIT.

1,060-kilovolt-ampere, twenty-five-cycle, three-phase banks of transformers, grounded neutral.

Two 45,000-volt, 6,000-kilowatt, three-phase outgoing lines.

Fig. 1 shows the system of connections specified by the Government, one line in this diagram representing the three phases. It will be seen that both high and low-tension buses are in duplicate, allowing ample flexibility for operation, testing, inspection and repairs. Two electrically operated oil switches are used in every circuit, and complete control of the system is therefore obtained at the benchboard. This arrangement is advantageous where it is important that there be no shut-downs of an appreciable length of time. With more than two transmission lines it would probably have been advisable to modify the connections to allow of isolating any line for testing purposes after the automatic switch had been tripped by a short-circuit or other line trouble.

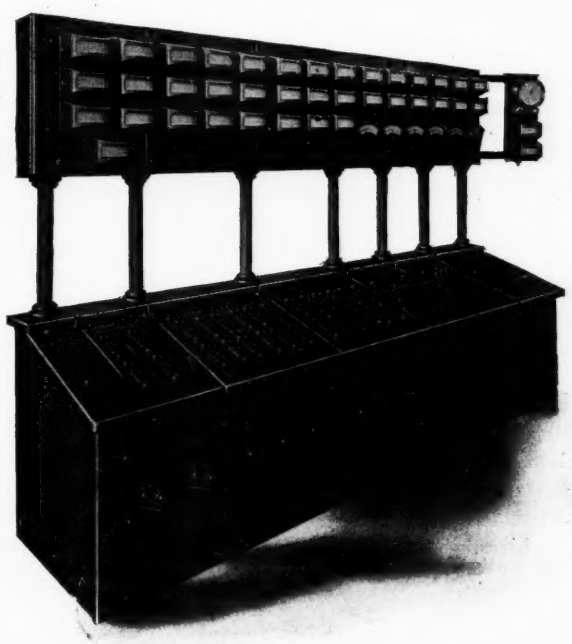


FIG. 5.—ALTERNATING-CURRENT AND DIRECT-CURRENT SWITCHBOARD, UNITED STATES RECLAMATION SERVICE, SALT RIVER, ARIZ.

All protective relays used on this board are of the time-limit type in order to prevent shut-downs due to momentary overloads. The definite time-limit overload relays on the lines will, of course, be set for such a current and time that they will take care of overloads or short-circuits external to the station. Generator relays are also definite time-limit overload and will be set so that the generator switches will be tripped only on account of large exchange currents at the time of synchronizing. Inverse time-limit overload relays are used on the transformer circuits, and are so connected that trouble in any transformer will automatically disconnect all the transformers but will leave the generators operating in parallel on the low-tension bus. That the Government engineers anticipate but little trouble with the transformers is evidenced by the fact that no provision is made in the transformer-protective devices for selective operation. By using series inverse time-limit overload relays on the high-tension side of the transformers, in addition to the low-tension relays, only the defective bank of transformers would be disconnected in case of trouble.

The low-tension oil switches are the General Electric Company's standard type F form K-4, as shown in Fig. 2, each complete switch consisting of three single-pole, single-throw elements operated by a single solenoid. The switches are mounted in fireproof cells, each pole in a separate compartment, with the solenoids in small subcells. The cell doors are made of asbestos lumber with a fireproof wooden framing and are pivoted at the top, but have no fastenings at the bottom. This light, free-swinging construction of cell doors has proven preferable to heavy doors which are fastened tightly to the cells, as the effect of explosions in the cells is temporary only, so far as the door is concerned. The disconnecting switches, bus-bars and instrument transformers are mounted on pipe framework above the oil-switch cells. As will be seen from the diagram of connections, disconnecting switches are provided on both sides of every oil switch, so that any switch can be inspected, tested and repaired without shutting down any of the circuits.

The high-tension oil switches are similar in construction to the low-tension switches, and are shown in Fig. 3. These type F form K-6 switches are operated in groups of three single-pole elements by solenoids mounted on top of the switch cells. The form K-6 switch is a top-connected device, but in this case the buses and disconnecting switches are necessarily located below the oil-switch cells. The adaptability of the switch to different arrangements will be appreciated when it is stated that the only change made in the ordinary layout with the buses above the switches was an increase in the size of the cells, this being necessary in order to obtain suitable striking distance from the leads to the ground. Masonry compartments are provided for the high-tension bus-bars.

Protection against lightning is obtained by the use of a three-phase aluminum-cell lightning arrester for each transmission line, these arresters being mounted outside of the station.

The benchboard proper consists of six panels of oiled black slate, the total height, including the instrument section, being eight feet two inches, and the length, exclusive of the swinging bracket, twelve feet seven inches. Facing the switchboard, the first panel at the left controls the two outgoing lines, the next two panels each controls three banks of step-up transformers, and the three panels at the right-hand end control two generators each. The alternating-current voltmeters and the synchronism indicator are mounted on a swinging bracket at the right-hand end of the board. The back of the instrument sections and control bench is entirely enclosed by removable grillework doors.

One alternating-current ammeter, one field ammeter and one polyphase indicating wattmeter are provided for each generator circuit. The two voltmeters on the swinging bracket are connected to the synchronizing bus in such a way that, when synchronizing, one indicates the voltage of the starting machine and the other the voltage of the bus-bars to which the incoming machine is to be connected. At other times the synchronism indicator is disconnected from the synchronizing

bus by means of a small snap switch mounted on the swinging bracket, and the voltmeters can then be connected to any machine by means of the synchronizing plugs, entirely independent of the synchronism indicator.

The synchronizing and control switches and the relays are mounted on the control bench. Two synchronizing receptacles are provided for each generator, one being used when synchronizing with bus No. 1 and the other when synchronizing with bus No. 2. Two sets of contacts in these switches are used for synchronizing purposes, but the third set of contacts is connected in series with the closing side of the corresponding oil-switch control switch, so that no damage can be caused by the operator becoming excited when synchronizing and trying to close the wrong oil switch. To assist the operator in synchronizing, a governor control switch is provided for each generator circuit, this being a double-pole, double-throw reversing switch connected to the governor motor.

The controlling switches for the oil switches and field switches are the well-known twin pull-button type as shown in Fig. 4, which also shows the indicating lamps or bull's-eyes. One button actuates the closing contacts and the other the opening contacts, and they are so interlocked that it is impossible to operate both buttons together. An indicator is provided on each switch, which shows green after the control switch has been operated to open the coil switch and red after it has been operated to close it. Being a pull-button switch, it is impossible to cause trouble by accidental pressure, and, as the contacts are behind the panel, there is no danger to the operator and no chance of accidental short-circuits. Severe arcs can not occur in the control switch on account of a solenoid control relay being used to open and close the closing coil circuit of the solenoid. The use of this relay, which is mounted close to the solenoid, makes it unnecessary to run large control leads to the bench-board. The indicating lamps are connected so that they show the actual position of the main switch—red when the oil switch is closed and green when it is open. If the indicating lamps and the switch indicator do not agree the operator knows that the oil switch has tripped automatically. When this has occurred the control-switch indicator shows red and the indicating lamps green. To make the indicating lamps plainly visible from a considerable distance or at an angle, a V-shaped projection is cast on the front of the lens.

Generator field rheostats are mounted below the switchboard gallery and are controlled by combination bevel-gear and chain mechanisms, the operating hand-wheels being mounted on pedestals in front of the switchboard. The field switches are solenoid-operated and controlled from the benchboard, the same type of control switch and indicating lamps being used as for the oil switches. As stated above, the exciter and field-switch panels are of the ordinary vertical type, two sets of bus-bars being used. As the field switches are single-pole, single-throw, it is necessary to connect double-pole, double-throw lever switches in series with them so that the fields can be connected to either bus.

Mimic bus-bars are mounted on the control- switch bench, and consist of small polished copper bars which have no electrical connection with any part of the circuit. They show the system of alternating-current connections exactly as indicated in Fig. 1, the controlling switches representing the oil switches and name-plates representing the generators, transformers and lines.

The overload relays provided for the generator circuits are single-pole, the secondaries of the current transformers being cross-connected. As the generators are three-wire machines, the third line necessarily carries the resultant current of the other two current transformers. This connection can not be used on the transformer panels as three ammeters are provided for the transformer circuits, and it was, consequently, necessary to use double-pole relays. On the middle generator panel is mounted the signal relay which is used to ring an alarm bell when any of the oil switches is tripped automatically. This relay is arranged so that the bell continues ringing until the operator releases the relay, and is connected in such a way that it does not operate when the oil switches are opened or closed by the switchboard operator.

Each transformer circuit and each line is equipped with three ammeters. In addition to these instruments there is one ammeter connected in the neutral bus so as to read ground currents. Controlling circuit equipments are similar to those for the generator panels. Synchronizing receptacles are provided for the line circuits, but not for the transformer circuits, the receptacles for the line circuits being intended for use when additional generator stations are placed in operation.

In conclusion, attention is directed to the general arrangement and equipment of the board. No panel is at all crowded, the control and measuring apparatus is simple, and no superfluous or infrequently used devices are included. The equipment for each circuit is segregated so that there is no confusion in emergencies. Many recent switchboards have been unnecessarily complicated and crowded on account of including elaborate testing equipments or other devices used only at long intervals of time, the designers apparently overlooking the fact that switchboards are primarily intended for constant use in controlling the machines and circuits. Simplicity in operation involves a corresponding simplicity in design and equipment, and insures reliability, which, in the large majority of central stations, is of the greatest importance.

The switchboard described above was designed and built by the General Electric Company, of Schenectady, N. Y., to meet the requirements set forth in the Government specifications, and has just been shipped to Arizona. The photograph was taken at the factory and shows the board exactly as it will be installed.

Allis-Chalmers Business.

An officer of the Allis-Chalmers Company, of Milwaukee, Wis., is quoted as saying:

"Business booked by Allis-Chalmers in July and August showed substantial gains compared with previous months. At one time we were operating only fifty per cent of our capacity, but it has since been increased to about seventy-five per cent. All plants are now being operated.

"While all departments have recorded gains in new business, the greatest increase proportionately is shown in the demand and orders booked for mining machinery.

"We are prepared to do an electrical business on a larger scale than heretofore, and a great deal will be devoted to street-railway equipment, the bulk of which work will be performed at our West Allis plant, recently enlarged at a cost of some $5,000,000. The smaller electrical contracts will be cared for by the Bullock Electric Manufacturing Company, one of the principal subsidiary concerns.

"The foreign department is booking a good business, particularly in South Africa, Japan, China and South America."

Report of Receivers of the Metropolitan Street Railway Company.

The receivers of the Metropolitan Street Railway Company, who were, until recently, also receivers of the New York City Railway, have issued a statement showing the income account of their property from the time of their appointment on September 25, 1907, up to the end of the fiscal year on June 30, 1908.

Not taking into consideration that the company, in the nine months' period, has defaulted about $4,700,000 in rentals to lines leased or under agreements, which amount does not appear as charged against income, the deficit for the above period was $1,047,682, as follows:

Period from September 25, 1907, to June 30, 1908:

Gross earnings:		
Cash fares		$11,497,007
Ticket fares		28,438
Mail		819
Express		20,883
Total		$11,547,147
Operating expenses:		
Maintenance of way and structures	$929,012	
Maintenance of equipment	1,912,254	
Operation of power plant	899,431	
Operation of cars	3,639,086	
Injuries and damages—expended	480,813	
Injuries and damages—deferred	686,264	
General	708,076	
Total		$9,263,838
Net earnings		$2,283,308
Other income:		
Advertising	$178,108	
Rental of land and buildings	109,521	
Rental of tracks	11,109	
Rental of equipment	8,712	
Miscellaneous interest	222,016	
Other income	4,744	
Total		$533,783
Gross income		$2,817,091
Deductions from income:		
Taxes, other than special franchise	$607,424	
Taxes, special franchise, estimated on basis of assessment for year ended December 31, 1907	599,812	
Rent of leased lines on which permanent default has not been made	2,156,727	
Interest on funded debts of companies whose roads are operated under agreements on which permanent default has not been made	79,083	
Interest on real estate mortgage	36,416	
Interest on floating debt	2,112	
Claims against companies in hands of receivers	393,197	
Total		$3,864,773
Net income—deficit, not including charges defaulted		$1,047,682

In addition to the above deficit of $1,047,682, there is a further expenditure charge of $344,883, resulting from operation, about which there is a disagreement as to whether it should be charged to the Metropolitan Street Railway Company or the New York City Railway Company. Allowing for this charge and for the $4,720,114 charges on account of interest on bonds and rentals of subsidiary companies defaulted, the total deficit would approximate $6,000,000.

A statement of the default on mortgage bonds and rentals follows:

Metropolitan Street Railway Co.:			
General collateral trust mortgage	$12,500,000	@ 5%	$625,000
4% refunded mortgage	16,604,000	@ 4%	664,160
Dividend rental on capital stock	52,100,000	@ 7%	3,640,000
Third Avenue Railroad Co.:			
First mortgage	$5,000,000	@ 5%	$250,000
First consolidated mortgage	37,560,000	@ 4%	1,502,400
Dividend rental on capital stock	15,995,800	@ 6%	959,748
Central Crosstown Railroad Co.:			
Dividend rental on capital stock	$600,000	@ 15%	$90,000
Fulton Street Railroad Co.:			
First mortgage	$500,000	@ 4%	$20,000
Totals	$140,759,800		$7,751,308
Central Park, North and East Rivers Railroad Co.:			
Dividend rental on capital stock	$1,800,000	@ 9%	$162,000
Twenty-eighth and Twenty-ninth Streets Crosstown Railroad Co.:			
First mortgage	$1,500,000	@ 5%	$75,000
Totals	$3,300,000		$237,000
Grand totals	$144,059,800		$7,988,308

The statement of default covers the entire twelve months. Representatives of the company said in reference to the defaults that consideration should be taken of the fact that the company no longer received the seven per cent on $52,000,000 stock guaranteed by the Metropolitan Securities Company, which amounts annually to about $3,500,000.

Provision is made for the special franchise tax on the basis of last year's assessment, but no provision is made for depreciation.

Assuming that the Metropolitan deficit, including the charge of $344,883 in dispute, was $1,392,565 for the period from September 25, 1907, to June 30, 1908, the receivers state that if the remaining charges on account of leased lines, aggregating $2,235,810 in interest and rentals were defaulted, the road would have a surplus from operation of $800,000 after paying taxes other than special franchise of $607,424, and making provision for special franchise taxes of $599,812.

The special franchise taxes have never been paid by the surface roads, and prior to this year no provision has been made for paying them. And up to the present time no fund has been created for the purpose, but their amount has been taken into consideration in calculating the deficit on the Metropolitan system.

Receivers for Long-Distance Telephone Company of Decatur, Ala.

On petition of Frank Caughring, of Toledo, Ohio, Judge Shelby, of the United States Court of Appeals, has placed the Long-Distance Telephone Company, of Decatur, Ala., in the hands of receivers. L. G. Barker, of Louisville, Ky., and Douglass Taylor, of Huntsville, Ala., are named as receivers. The bonded debt of the company is estimated at $586,000.

New Haven's Control of the Portchester Lines.

At the hearing of the Public Service Commission for the First District, New York, in the matter of the New York & Portchester Railroad, the following statement was submitted concerning the disbursement by the New York, New Haven & Hartford Railroad Company of $11,000,000, paid for the control of the Westchester and Portchester companies:

"The New York, New Haven & Hartford Railroad Company owns 990 shares of the capital stock of the Millbrook Company out of the authorized issue of 1,000 shares, par value $100.

"The Millbrook Company owns (1) 91,581 shares of capital stock of the New York & Portchester Railroad Company, par value $100. Total issued, 91,590 (nine shares held by directors), and (2) one temporary five per cent first mortgage gold bond of New York & Portchester Railroad Company for $100,000.

"The New York & Portchester Railroad Company owns (1) 7,260 shares capital stock of the New York, Westchester & Boston Railway Company, par $100; (2) 23,614½ shares of capital stock of New York, Westchester & Boston Railway Company (voting trust certificates); (3) five shares of capital stock of the City & County Contract Company; 6,895 shares of capital stock of the City & County Contract Company (voting trust certificates); total number of shares issued City & County Contract Company capital stock is 6,890; and (4) an underwriting agreement to the amount of $13,490,000 cash to bonds and stock of New York, Westchester & Boston Railway Company. On this underwriting has been paid $4,819,120. Upon payment of balance, New York & Portchester Railway Company will be entitled to receive 13,490-13,500 of $15,000,000 par five per cent Westchester bonds and 45,000 shares of Westchester capital stock. These securities now being held under the syndicate agreement by Knickerbocker Trust Company, depositary for the syndicate managers.

"The total amount of cash advanced by the New York, New Haven & Hartford Railroad Company is $11,265,000. Of this amount $10,873,169.04 was expended in acquiring the securities of the several companies as detailed above, and the remainder, $391,830.96, is represented by demand notes or open account of the several companies. What securities will be issued against this amount can not as yet be determined."

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Kiebitz's Directive Arrangement for Electric Waves.

A brief description is given here of a directive system for electric waves which has recently been patented in Germany by Dr. F. Kiebitz. In the arrangements hitherto proposed for this purpose use has sometimes been made of some form of compound oscillator—that is, one in which an electric or open oscillator is combined with a closed oscillator. Dr. Kiebitz's device consists of a new arrangement of the compound oscillator. Although it has been tried over short distances only, sufficient data are given for an energy diagram to be plotted. In it the directed electromagnetic waves are excited by giving the radiating system such a shape that although the electric and magnetic systems generated in space have each an axis of symmetry, the two axes are in this case perpendicular or make an acute angle, while at the same time the direction of the magnetic force is inclined to that of the electric force. In this case the plane of the greatest magnetic force is inclined to the plane of the greatest electric force, the line bisecting the enclosed angle being in the direction of the greatest energy emission. The same device can be used at the receiving station, when it then absorbs chiefly those waves having the direction in which it is set. The arrangement consists of a solenoid with its ends connected to two metal surfaces. When such a system is excited inductively the electromagnetic field which it sets up consists of a magnetic doublet oscillating in the direction of the axis of the solenoid and an electric doublet oscillating in the direction connecting the two metal surfaces. The electromagnetic field thus has a minimum in the plane containing these two directions and a maximum at right angles to it. Nothing is changed when the earth is substituted for one of the metal surfaces, the direction of the maximum force then being along the earth. Experiments with this apparatus have been conducted both in the laboratory and in the open. The wavelength employed was twenty-two metres and the received energy was measured thermally. On revolving the transmitter in the laboratory a diagram of received energy was obtained having the form of a narrow lemniscate. In the open the ratio of maximum to minimum energy received was 70 to 1. A directive receiver gave the same results. With an electrolytic receiver at thirty metres, receiving distinct signals at zero degrees, rotation of the arrangement through thirty degrees caused the signals to cease. Before the practical value of the apparatus can be determined, experiments on a larger scale must be conducted.—*Abstracted from the Electrician (London), July* 31.

Weaving Concrete Poles.

A type of reinforced concrete pole, developed and used to some extent in Germany and just introduced into England, is described here. These poles are made in a machine invented by Hans Siegwart. They are hollow and tapering, in lengths up to about forty feet. The machine is capable of making columns of any size and lengths within the limits of forty feet long and two feet in diameter. Pipes can also be made in lengths three or four times as great as those customary for iron pipes. In the process of manufacture a long sheet-iron core is mounted on two trestles, running on rails, so as to be capable of rotational and longitudinal movements. Upon this core small longitudinal steel rods are fixed. The core is drawn through the machine, which is stationary. Concrete made of clean screened grit and Portland cement is mixed dry in a mechanical mixer and discharged through a chute into a hopper or drum, in which rotating paddle-wheels regularly discharge the concrete upon a bandage of coarse webbing laid on a conveyer belt, that takes one lap around the core. This continuous traveling conveyer belt is stretched so that the concrete is wrapped about the core under great pressure. As the core issues beyond the conveyer belt, wire is fed spirally around it so as to press into the concrete wrapping, and small rollers then apply great pressure by working on the webbing, the slack of which, caused by the reduction in diameter, resulting from this pressure, is taken up by another device. The core as it issues from the machine is wrapped about spirally with a bandage of cloth. The machine pulls the trestles forward with the suspended core as the concrete is wrapped on, and when the core has passed completely through the machine it is lifted by an overhead crane and laid to one side to harden. It is kept constantly damp so as to secure the maximum hardness. In about twelve hours the interior sheet metal core is reduced in diameter by means of a screw attachment inside and withdrawn. After hardening six days the bandage of webbing is removed and the pole is then complete for setting. Poles are made up to thirty-nine feet long and pipes up to twenty feet, two feet in diameter. The poles are estimated to have a life of fifty years, and during that time will cost nothing for maintenance. On this basis the total cost of an electric railway pole at the end of fifty years is estimated to be $20 for the concrete pole, $50 for an iron pole and $53 for a wooden pole, all including maintenance, repairs and renewals. This is for a twenty-nine-foot pole. For a thirty-six-foot pole for transmission service, and for the same period, the corresponding figures are: for the concrete pole, $26; for the iron pole, $68, and for the wooden pole, $68.50. Any desired amount of ornamentation may be given to the poles. Some tests on a pole of this type, thirty-two feet nine inches long, showed a deflection of two and three-quarters inches with a tensile strain of 15,000 pounds. The process is also applicable to the manufacture of concrete piles.—*Abstracted from the Electrician (London), July* 31.

The Nature of the Gamma and X-Rays.

A reply to certain criticisms of the neutral-pair theory of gamma rays, proposed by W. H. Bragg, is made here by him. Several objections have been raised by Dr. Barkla, all relating to this theory as applied to explain the behavior of secondary X-rays, as the latter thinks these rays are convincing proof of the ether-pulse theory of gamma rays. One of these refers to the equal penetrating powers of primary and secondary rays in certain cases. Mr. Bragg thinks that this is a natural consequence of any corpuscular

theory. Another objection is the supposed equality in the proportion of rays of different penetrating power which are scattered. Mr. Bragg says this fact has not been conclusively proved, and if it be a fact, it is not inconsistent with the corpuscular theory. The same may be said of the proposed law of the distribution of the secondary scattered rays. The law is of limited application only, and not irreconcilable with the neutral-pair theory. Again, Dr. Barkla points out his discovery of the fact that the ratio of the quantity of secondary radiation to the quantity of primary radiation depends only on the density of the gas producing it. Others have not been able to verify this law except when used within such narrow limits that any other theory would hold equally well. Moreover, J. J. Thomson made use of this ratio in determining the number of electrons in an atom. Two other objections, related to the polarization effects, have already been answered by Mr. Bragg, and the remaining ones are based upon remarkable effects observed by Dr. Barkla and a few others, but not yet satisfactorily established. In Mr. Bragg's opinion none of the proposed theories can be considered as offering a satisfactory explanation of these phenomena, hence the neutral-pair theory is no worse off than any other. On the other hand, the ether-pulse theory will need radical alteration before it will explain satisfactorily the asymmetrical effects of the gamma rays noticed by Dr. Madsen and the author.—*Abstracted from Nature (London), July 30.*

The Teaching of Mathematics to Students of Engineering from the Standpoint of the Practising Engineer.

Mathematics is to the engineer what anatomy is to the surgeon, what chemistry is to the apothecary, what the drill is to the army officer — it is indispensable. This is the opinion of Ralph Modjeski, the well-known bridge engineer. There is much agitation at this time in France and Germany, especially in the former, favoring the limitation of the mathematical programme at present in force in the engineering schools, on the ground that it is unnecessarily extensive. From personal observation Mr. Modjeski says that the programme in the two countries mentioned covers a considerably wider range than in the average American college. In the first place, a student entering an engineering college in Europe must already know analytical geometry, the rudiments of differential and integral calculus and descriptive geometry, none of which is taught here until after the student enters college. The average length of the engineering course in Europe is four years; hence the student in the European college has more time for practical studies than the student in the American college. Mr. Modjeski believes that the time will come when only applied mathematics will be taught in the engineering college, and all necessary abstract mathematics will be required for entrance. As one result of the specialization now going on in engineering there is not the same need for advanced mathematics among all branches. The bridge engineer and the electrical engineer require more advanced mathematical training than the railroad official; while the latter needs greater knowledge in other lines, such as geology. The question then arises, Will it be desirable and possible to specialize in mathematical courses in college and adapt them to each branch of engineering? This is done at present to a limited extent only in applied mathematics. Although bridge engineers require probably as advanced training in mathematics as any other engineers, Mr. Modjeski has not found the higher mathematics which he learned at college in France of any use to him. One reason for this is that it was not taught so thoroughly as to become second nature; and unless this is the case advanced mathematical instruction is of not much value to the engineer. One can not be said to know a foreign language until he thinks in it; nor can he be said to know his mathematics until he thinks mathematically. It is not necessary for him to go to the higher mathematics, but it is necessary to be thoroughly drilled in the elementary principles of each subject. When these have become second nature, problems which arise every day in the practice of the engineer are easily solved without going into calculation. With a proper foundation the engineer's mind becomes so trained that he applies unconsciously these fundamental principles; they direct his line of thought automatically. How to secure such a foundation is the problem of the engineering college.—*Abstracted from Science (New York), August 7.*

The Petrol-Electric Drive and Other Mixed Systems.

The flexibility and serviceability of the electric transmission system for self-propelled vehicles is held by Frank Broadbent to be more than an offset to a somewhat greater fuel consumption, should this be found to result from the adoption of the system. After recalling the pioneer vehicle of this type, the Heilmann locomotive, which, he says, was not given the proper sort of trial, as it was tested in connection with steam locomotives for fairly long hauls with few stops, some of the recent systems are described. The North-Eastern Railway Company, of Great Britain, has two gasolene-electric cars in service on its Hartlepool branch. These are equipped with an eighty-five-horse-power four-cylinder engine, direct-connected to a fifty-five-kilowatt compound-wound generator which drives two fifty-horse-power motors. Several somewhat similar cars are in use in Hungary and have given good results. The fuel costs are reported to be 1.5 cents per car-kilometre. The maintenance costs are about 0.8 cent for a gasolene-electric car, which may be compared with 0.97 cent for a similar straight gasolene car; with 1.1 cents for a steam car, and 2.4 cents for a steam locomotive, all for the train-kilometre. The fuel costs for a steam car are given by the same authority as 0.9 cent, which is favorable to this system. But when all costs are considered the mixed system makes a better showing. The total costs for the steam car are given as 6.24 cents a car-kilometre, while the corresponding cost for the gasolene-electric car is only 5.73 cents. Moreover, the former figure is the average of 1,591,411 kilometres, while the latter is the average of only 135,048 kilometres, and would probably be lower for a longer use. In addition, for frequent service, where the stops are many, the better starting characteristics of the mixed system give it a decided superiority. One of the most recent systems is that proposed by Smith and Stevens. A dynamo with a falling characteristic is coupled to a gasolene engine and supplies current to two series motors. By this arrangement a constant torque is developed, irrespective of the speed. The speed is controlled by varying the speed of the engine. When the engine speed is reduced to a certain point the dynamo drops its excitation and the motors stop. Thus it is not necessary to stop the engine in order to bring the car to a standstill. For the highest speeds the resistance of the shunt field winding of the dynamo is lowered, while for the lower speeds the motors are connected in series, enabling them to develop full torque at the lowest speeds. While this system has been put forward for road vehicles, it is as suitable for local traffic on railways or any similar service. When all costs are considered it is thought that a gasolene-electric bus would show an economy of four cents a mile in running costs, and a corresponding saving should result from a proper use of this system for railway traffic.—*Abstracted from the Electrical Review (London), July 24.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Central Station Transformers.

The manufacture of transformers of fifty kilowatts and smaller—known among central station men as "lighting" or "central station" transformers, in contradistinction to the so-called "power" or "transmission" transformers, of sizes above fifty kilowatts—presents certain special problems which are only to be solved by manufacturers having years of experience in the design and construction of apparatus of this character. These problems are entirely apart from the question of type (whether "core type" or "shell type"), which may be a matter of individual preference or precedent on the part of the transformer builder, and which is in any event a manufacturer's question and not one in which the customer is materially interested.

The experienced builder of central station transformers must, first and foremost, understand the conditions that confront the operating companies. One of the most important of these conditions is the compulsion that the companies are under to meet their service requirements with minimum investment in transformers. This condition does not mean the selection of transformers on a criterion of low first cost; on the contrary, it means that the careful buyer, in making his yearly contracts, or in individual purchases, will give greater weight to efficiency, reliability and life than to saving in first cost of installation. The unwisdom of being blinded by the latter consideration, to the exclusion of other and more vital ones, has often been exemplified in the disappointment and loss occasioned by buying transformers of incorrect design or poor materials, or both. Such apparatus is bound to fall short in the important features of core and copper losses, insulation, cooling and general ruggedness in service—in all of which features the user is vitally interested.

Another condition is the necessity of good regulation which is recognized as essential to satisfactory lighting service, and which is essential no less to the satisfactory load performance of motors. The importance of good regulation in the latter service may be clearly shown. The prevailing types of alternating-current meters all operate on a power-factor varying from fifty to ninety per cent, depending on the percentage of load carried. On the other hand, it is well known that the load capacity of any alternating-current meter drops with the square of the fall of pressure supplied to the meter terminals. For example, a ten-horse-power motor at a pressure of 110 volts will have a capacity of only eight and one-quarter horse-power if operated on 100 volts. Since a drop of ten volts may easily occur in the transformer if the latter be of poor design with respect to regulation, the importance of the wise selection of transformers to meet such conditions is obvious.

Intimately connected with the preceding is a third condition, *viz.*, the way in which transformers of poor regulation menace the service of the central station company by shirking their load. Thus, if transformers of poor regulation are connected in parallel with transformers of good regulation, as the load increases the former will, by falling off in voltage, shift a good part of their share of the load on to the latter, which will thereby be overloaded and may even be burned out.

The Wagner Electric Manufacturing Company, of St. Louis, Mo., has specialized in the manufacture of transformers since 1891. Its experience and its recognition of the needs of the central station companies, as above outlined, have resulted in a line of central station transformers having the following operating characteristics and features of design and construction:

In the first place the practice of this company is to employ in its central station transformers substantially the same features of electrical and mechanical design as are employed in power transformers, with the object of attaining thorough reliability in service and long life, and the maximum efficiency consistent therewith. Fig. 1 and Fig. 2 are views of the transformer element with case removed and of

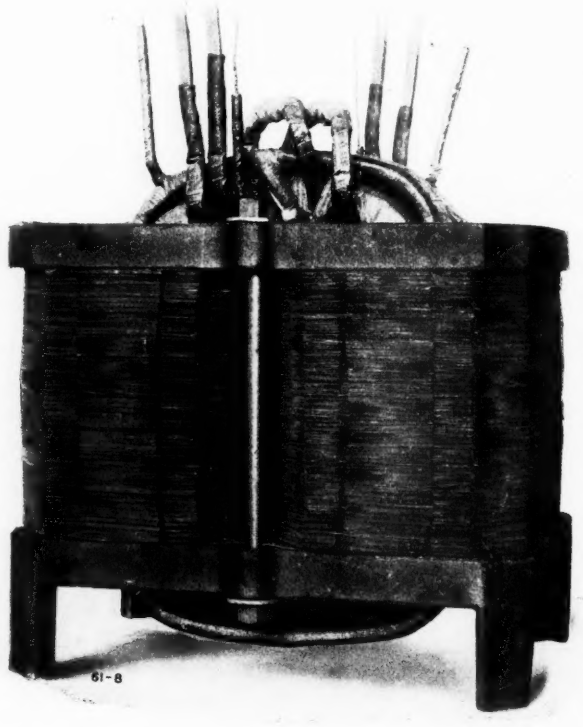


FIG. 1.—WAGNER SINGLE CENTRAL STATION TRANSFORMER, WITH CASE REMOVED.

the complete transformer, respectively. It will be seen that the transformer is of the shell type, which is employed by all manufacturers of high-tension and large apparatus. In this form of construction the magnetic circuit of laminated sheet steel is built up around the copper coils of

FIG. 2.—FIFTY-KILOWATT WAGNER CENTRAL STATION TRANSFORMER, COMPLETE.

the primary and secondary windings; whereas in the core type the relative positions of magnetic circuit and copper coils are reversed—the coils enclosing the limbs of the magnetic circuit.

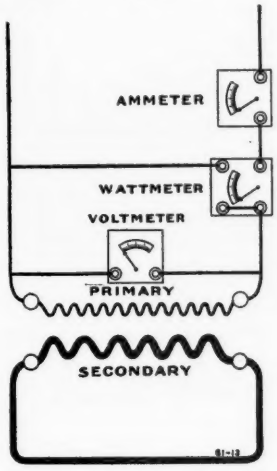


FIG. 3.—CONNECTION FOR IMPEDANCE TEST OF TRANSFORMER.

The use of the new, so-called "alloy-steel," which the Wagner company employs, has resulted in marked advantages. Transformer cores built of this steel show not only marked reduction of initial core losses, with corresponding reduction in all-day efficiency, but also freedom from "aging" and consequent lowering of efficiency from heating of the transformer in operation.

The new steel gives a transformer having lower internal losses than has hitherto been produced, and also one in which aging is eliminated. Previous to its introduction, the operation of apparatus of this character was wisely restricted to the temperature limits prescribed by the American Institute of Electrical Engineers, for the reason that the sheet steel then employed in transformer construction aged rapidly if heated much above these limits. In the present transformers the criterion of heating is not under this restriction, but is the safe operating temperature of the insulating materials employed, although it has not been deemed wise by the company to modify the standard temperature limits that have hitherto obtained.

Unusually effective oil cooling and insulation is another salient feature of these transformers. The secret of success in properly cooling a small transformer consists in affording the oil ample opportunity to reach all the active materials. That this result is not only possible but is actually accomplished in Wagner transformers is due to the peculiarly efficient method of spacing all the parts. There are no wide individual coils in these transformers, but the coils are so subdivided as to make the interlacing layers comparatively narrow. This spacing not only permits free circulation of the oil and the maintenance of all parts at a uniform temperature, but it also reduces to the smallest working limits the pressure between layers, thereby practically eliminating the liability of puncture between them.

Wagner central station transformers do not depend upon the oil for internal insulation. All of the customary guarantee insulation tests are made upon the transformers, and sustained successfully by them, before adding the oil. The insulation of these transformers is, therefore, extraordinarily good since the effective dielectric strength of the oil is added to the already high insulation of the transformer structure due to the design. Moreover, in the construction of the transformer no insulating compounds are used that can dissolve in, or be affected by, the oil.

The attaining of excellent regulation has been made a matter of the first consideration in the design and construction of the Wagner central station transformers, which are designed with a view to their employment on either lighting or small-motor service. An approximate rule for determining whether two transformers of the same size but different makes will operate satisfactorily in parallel is to compare them on what has been termed the "impedance test" applied to each of the transformers in turn. As shown in the accompanying diagram, Fig. 3, this test consists in short-circuiting the secondary and applying an alternating current of low voltage—not exceeding two to five per cent of the normal operating voltage—to the primary, adjusting the value of the current until full-load current flows through the latter. A wattmeter inserted in the circuit will then indicate roughly the actual full-load copper loss of the transformer under service conditions. If the wattmeter and voltmeter readings are about the same for the two transformers, the latter will operate fairly well in parallel.

New Mining Property Adopting Electricity—Westinghouse Motors to Be Used.

The Virginia & Mexico Mining and Smelter Corporation, of Hostotipaquillo, Jalisco, has in transit from the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., whose agents for the republic are Messrs. G. & O. Braniff & Company, a number of electric motors to be used in connection with its new mill. There will be some fifteen motors, totaling over 300 horse-power, the majority of which will be used for belt drive. There is to be a thirty-stamp mill, each fifteen stamps driven by a separate thirty-horse-power motor. A twenty-horse-power motor will drive ten Wilfley concentrating tables. One thirty-horse-power motor will be used to drive three crushers, and a second thirty-horse-power motor to operate air-compressor, mechanical agitator and vacuum pump. These last are for use in connection with the slime agitation and the Butters filter press which is to be installed. Another thirty-horse-power motor will be installed to drive three solution pumps and three Frenier pumps. A ten-horse-power motor will operate a Robins belt-conveyor for handling the sands, etc.

The above mill is to be one of the most modern in the republic, and the extraction obtainable will be correspondingly high, partly due to the modern machinery, and partly on account of the better efficiency obtained by the use of individual motor drives on the separate machines. Jesse Scobey is manager of the property.

Moving-Picture Machines on Alternating-Current Mains.

In the earlier days of the adaptation of the focusing arc light throwing a ray of light through a moving film, objections came from the users of alternating-current arcs, which caused the engineering department of the United Electric Light and Power Company, supplying alternating current throughout New York city, some concern. This subject is interestingly discussed by T. I. Jones in the current *Bulletin* published by the National Electric Light Association. These earlier objections included hissing at the arc, flickering and occasional black spots in the picture.

The study of this trouble showed that the black spots were most noticeable when the films had reached a given speed. This speed was found when the number of single pictures passing in front of the arc equaled the alternations per second of the current supplied. In other words, at certain times the arc was absolutely out when the picture passed in front of it; or if the arc was not actually out the difference in illumination due to the red carbon when current was absent and the incandescent carbon when current was present was sufficient to cause the black spots complained of on the screen. These black spots, therefore, had a direct bearing on the frequency of the current, as it followed that where the frequency was higher the number of spots was less and with lower frequency the spots increased.

Combinations of two or more arcs were suggested, also changes of frequency of the current supplied. These suggestions, however, simply bettered without removing the condition. Accordingly, the matter of mercury rectifiers was taken up with the engineers of the United company, and in conjunction with both the Westinghouse and General Electric companies a rectifier was designed adaptable to moving-picture machines.

One of the important features in the design of the rectifier was the starting apparatus, by means of which the act of closing one switch, placed at any location, and closing the carbon switch started the entire outfit.

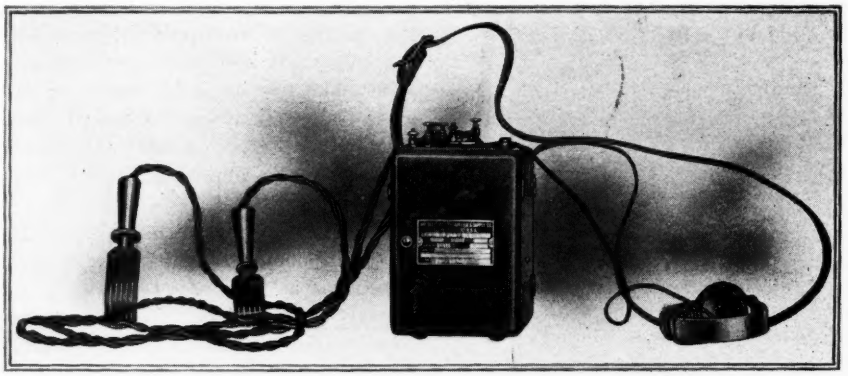
The direct current obtained from the rectifier removed the frequency trouble of black spots, and the use of the transformer of the rectifier outfit has a material advantage over the direct-current 110-volt street supply in that it is not necessary to use a rheostat in series with the arc to cut the voltage from 110 down to the voltage of the arc—about fifty-five. These rectifiers are now used in a number of moving-picture places in New York city.

The Electric Fault Finder.

A new and useful instrument has just been brought out by the Electric Controller and Manufacturing Company, of Cleveland, Ohio, for detecting and locating grounds, short circuits, open circuits, leaks and other faults in armature coils, field coils, control circuits, switchboard wiring or any other electrical circuit. Its name, the "electric fault finder," truly describes its use since it not only indicates trouble, which is all that a magneto will do, but finds or locates the trouble. With the electric fault finder, for instance, in a motor armature a faulty coil can be absolutely located and the nature of the trouble definitely told. If a field coil is damaged the layer in which the fault lies can be absolutely determined. If there is trouble in a bunch of control wires in a multiple-unit train control, or other magnetic switch control, the faulty wire or pair of wires can be promptly located and the nature of the fault quickly found.

As will be seen from the accompanying views, the instrument consists of a small box provided with a strap so that it can be slung over the shoulder when testing motors in place, such as under a car or on an electric overhead traveling crane. From this small box leads go to a telephone receiver fitted with a headpiece so as to leave both hands free for testing. For working in very noisy places, such as bridge and boiler shops or some parts of steel mills, the headpiece may be fitted with two receivers, one for each ear, which will shut out all sound save that received from the instrument. This arrangement not only allows perfect testing to be done in noisy places but enables partially deaf persons to use the instrument. In one case, by adjusting the rheostat to give a very loud sound (more than the normal ear could stand) and using two receivers, a very deaf man did very accurate work with this instrument. From the box leads of convenient length go also to two test terminals.

The electric fault finder is cheap, small, portable, and requires no outside current to operate. It requires only one man to operate under any conditions, so there is no excuse for the tester desiring a helper.

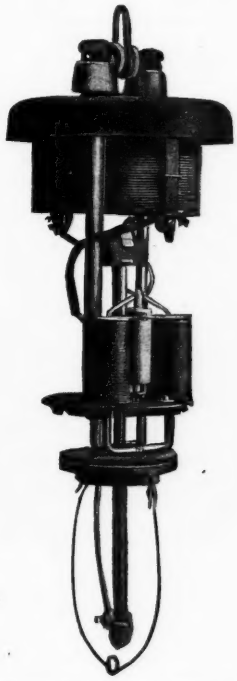


A New Electric Fault Finder.

Using the Electric Fault Finder.

The Westinghouse 110 and 250-Volt, Multiple, Direct-Current Arc Lamps.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has developed a 110 and 250-volt, direct-current arc lamp for installation where the lamp may be operated under very severe conditions. The design has been adapted especially for mills, factories and other places where a unit of delicate mechanism would not be suitable. The construction of the lamp has been simplified to the last degree, and its parts are few in number. The mechanism is of ample strength and is easy of access and thoroughly protected. The lamps are designed primarily for 110 and 250 volts, direct current, but can be adjusted to operate between the limits of 100 and 125 volts, and 200 and 260 volts, respectively. The normal current taken by these lamps when adjusted for normal voltage is four and one-half and two and three-quarters amperes, respectively. The normal life of one set of carbons is from 125 to 150 hours.



INTERIOR VIEW, MILL TYPE DIRECT-CURRENT ARC LAMP.

EXTERIOR VIEW OF MILL TYPE DIRECT-CURRENT ARC LAMP.

The lamp case consists of a single piece of sheet copper of cylindrical shape, finished in black japan. The mechanism of the lamp may be entirely exposed by removing the outer globe, turning the case through a small angle and lowering it. Numerous openings are made in the case through which air passes into the lamp. The air passes out through a space between the upper part of the case and the upper casting. This current of air circulates around the resistance coils in the upper part of the lamp and provides ventilation.

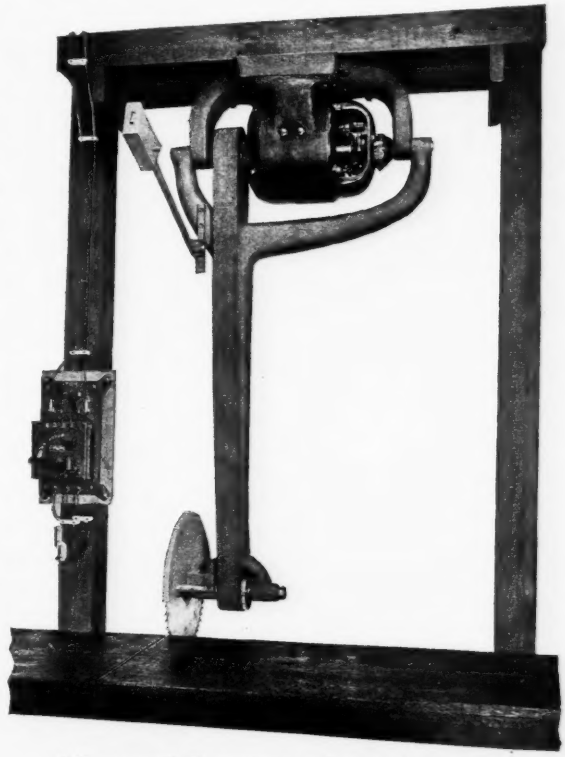
The magnet coils are wound with asbestos-covered wire and all the windings in the lamp are fireproof. The windings are so proportioned that even on a short-circuit test of several hours' duration no deterioration of the insulation nor burnouts will develop. This insures immunity from burnt-out coils whatever the exigencies of the service.

The outer globe or shade is held in place by an adjustable ring with two latches which are used for fastening the globe to the lamp housing. These latches are large and convenient to manipulate and permit the globe to be quickly released for trimming. During the operation of trimming the globe hangs suspended by a chain provided for the purpose.

Exports of copper for the first seven months of 1907 were 97,160 tons. Imports of copper for the first seven months of 1907 were 79,000 tons. Exports of copper for the first seven months of 1908 were 181,711 tons. Imports of copper for the first seven months of 1908 were 46,000 tons.—*Copper Gossip.*

The "Reliance" Electrically Driven Swing Saw.

The accompanying illustration shows the "Reliance" electrically driven swing saw placed on the market by Carse Brothers Company, 165 Broadway, New York city. In this saw compactness, simplicity and strength have been combined with great rigidity. The weight has been kept as low as is consistent with the best engineering practice. The bearings of the arbor are long, self-aligning and of the best grade of babbitt metal. The base of the saw is made in one piece, and there is no twisting, sagging or lost motion of the swinging arm. The apparatus may be mounted either on the ceiling or on a side wall. It can be supported on standards attached to a bench, and when mounted on a bench may be used as a portable tool and moved with the bench from place to place to suit the demands of the work being done.



"RELIANCE" ELECTRICALLY DRIVEN SWING SAW.

The starting box and switch are placed in a convenient position, and the operator can start and stop the saw at will. The base supporting the motor is of cast iron, heavily ribbed, and the saw frame is a hollow cast-iron cylinder, strong and rigid. The saw is counterbalanced so that it automatically returns when the handle is released.

Current Electrical News

DOMESTIC AND EXPORT.

NORTHERN COLORADO POWER COMPANY—Harry Bronner, George C. Smith and James N. Wallace, voting trustees of the Northern Colorado Power Company announce that a meeting of the holders of voting trust certificates for preferred and common stock will be held on September 5 to vote on the authorization of a $6,000,000 issue of five per cent bonds to be secured on the property and franchises of the company.

NEW MEXICAN POWER COMPANY—The Atotonilco Light and Power Company has been organized in Guadalajara with a capital of $50,000 to install a hydroelectric plant and furnish light and power to the town of Atotonilco and to haciendas and industrial plants in the tributary territory. Atotonilco is the centre of the orange district of Jalisco. The officers of the new company are: Enrique Alvarez del Castillo, president; Francisco Muñoz, vice-president; Alfredo Gonzalez, secretary; José M. Corvera, treasurer, and Alfredo Gallardo, general manager. The other stockholders are Manuel Cuesta Gallardo, Dr. Felipe Valencia, Carlos Hering, Vicente Orendain, Frederick M. Newton, José C. Dieguez and Dr. Carlos Barriere. In the generation of electric current the new company will use the Faretan waterfall near the town of Atotonilco. The water drops a distance of seventy-five feet, and power sufficient for all needs in that section can be developed. Alfredo Gallardo, general manager of the new company, is responsible for the proposed enterprise. He planned the utilization of the waterfall and promoted the company.

NEW IOWA ELECTRIC ROAD—With a view to the construction, equipping and operating of a combination steam and electric railroad between Council Bluffs and Des Moines, Iowa, *via* Treynor, Carson, Oakland, Walnut, Elkhorn, Exira, North Branch, Guthrie Center, Panora and Dallas Center, a company with an authorized capital of $1,000,000 has been organized at Treynor, Iowa, a preliminary survey made and bonds, it is said, guaranteed. The Metropolitan Trust and Savings Bank, of Chicago, is quoted as financing the movement to a large extent, and that part of the work is practically completed. The road will be fourteen miles shorter than any now in operation. Gasolene or electricity will serve for passenger service, while steam is to be used for heavy traffic. The right of way will be secured at once and construction work begun in early spring. The officers chosen were as follows: President, G. W. Adams, Walnut; vice-president, C. L. Kirkwood, North Branch; treasurer, A. L. Ingram, Treynor; secretary, Peter Kaghmann, Treynor; general attorney, Orran Mosher, Jr., Walnut. Directors—S. B. Shultz and Arthur Saar, Treynor; V. B. Spangler, North Branch; G. L. Artist, North Branch; Charles Peterson, Walnut.

ELECTRIC RAILWAYS.

SCRANTON, PA.—Work has been begun on a new power-house for the Scranton Street Railway Company.

BROOKINGS, S. D.—The city council has granted a twenty-year franchise to the Brookings & Sioux Falls Railway Company.

APPLETON, WIS.—Plans for building an interurban line with local capital to New London by way of Hortonville are under discussion.

ALTOONA, PA.—An electric line from Altoona to Wopsononock, and over the mountain to Dougherty and Patton, is being considered by local business men.

LEWISTON, IDA.—Contracts for the grade work on the Johnson electric road between Nezperce and a connection with the Culdesac-Grangeville line have been awarded.

ARGENTA, ARK.—The town council has granted a new franchise to the Argenta Street Railway Company. The city light plant will furnish the necessary current to the railway company.

MIDDLETOWN, N. Y.—Capitalists are planning the construction within a short time of an electric railroad from Goshen to Central Valley and over the mountain to Haverstraw, to be called the Hudson River Traction Company.

KANSAS CITY, MO.—The Kansas City-Olathe Electric Railway, building south from Rosedale to Olathe, is now completed as far as Shawnee, Kan. Work is being pushed on the remaining part of the road from Shawnee to Olathe.

LOUISVILLE, KY.—The needed finances having been secured from a Boston bank, the Louisville & Eastern will complete its electric line from Louisville to Shelbyville, a distance of thirty miles. The line to Lagrange is now complete.

ELKINS, W. VA.—The power-house of the Elkins Electric Railway Company will be built by October 1 at Roaring Creek Junction, by which time it is stated cars will be running. President J. C. McSpadden states that the line will be complete to Harding this fall.

AURORA, ILL.—The Aurora, DeKalb & Rockford electric line has been sold to Edwin Bailey, of Boston, to satisfy creditors. Securities worth $835,000 par value were sold for $185,000 to Mr. Bailey, who, President Fred Dolph, of the Aurora Railway Company, says, has interests in common with him.

NEW HAVEN, CT.—The Connecticut Company, a holding corporation for the New York, New Haven & Hartford electric traction service, has awarded to C. W. Blakeslee & Sons, of this city, the contract for a trolley line from Middletown to Wethersfield, eleven miles, at an estimated cost of $400,000.

ROCK ISLAND, ILL.—At a meeting of promoters of the Rock Island Southern Interurban, from Monmouth to the tri-cities, held at Davenport, it was decided to build the connecting line in order that Aledo may be included. The line will be constructed from Preemption to Monmouth by way of Viola.

MEXICO CITY, MEXICO—The Mexico Electric Tramways Company has applied to the superior council of the federal district government for permission to build a new line to reach the new Covadonga Park of the Spanish colony in time to establish the service before the next Covadonga festivities in September.

CLARKSBURG, W. VA.—At a meeting of the Morgantown & Dunkirk Valley Traction Company, at Blacksville, it was ordered that the first section of the road, extending five miles out of Morgantown toward Wadestown, be commenced at once. Amri Martin, of Morgantown, was named as superintendent of construction.

WHITE PLAINS, N. Y.—Arrangements have been completed between the Tarrytown, White Plains & Mamaroneck Trolley Company and the Westchester Lighting Company, by which the latter is to furnish the power with which the line will be operated. Three additional lines will be strung between New Rochelle and White Plains.

PITTSBURG, PA.—A syndicate of Pittsburg and Butler men has plans for the building of an interurban traction line from Butler to Slippery Rock by way of West Sunbury. It is planned to run through cars from Pittsburg to Slippery Rock over the proposed stretch and the Pittsburg & Butler line, which would compete most of the way with the Bessemer railroad.

BILLINGS, MONT.—The sale of a franchise for an electric street railway, which was granted to Yegen Brothers by the city council some months ago, has been effected, N. S. Poole, an electrical engineer of Townsend, being the purchaser. It is stated that Yegen Brothers retain some of the stock and that a company will be organized for the purpose of constructing a line in the city and through the valley.

MASON CITY, IOWA—Charles City, Greene, Parkersburg, Allison, Grundy Center, Marshalltown and other smaller intervening points are interested in a proposed electric line from Marshalltown north to Charles City and probably beyond. Several meetings have

been held and interest in the scheme has been awakened. It will take $600,000 to carry through the enterprise, and this must be raised by the cities and towns interested.

ALBANY, N. Y.—The Public Service Commission has granted permission to the Champlain & Sandford Railroad Company to construct an electric line fifty-eight miles in length in Essex County. The proposed line will tap the ore mines in the vicinity of Lake Sandford and connect with the Delaware & Hudson at Riverside. A magnetic survey shows that there are 300,000,000 tons of ore in the territory which will assay fifty per cent iron.

ALTON, ILL.—A new trolley line from Alton to Jacksonville, sixty-four miles, is in prospect through the announcement of the Alton Construction Company that work on the new Alton, Jacksonville & Peoria road will begin September 15. The line is now built from Alton to Godfrey, a little more than four miles. The money to build through to Jacksonville is said to have been pledged by a European syndicate. An extension to Peoria is planned later.

RICHMOND, VA.—Colonel C. P. E. Burgwyn and a corps of engineers have begun a survey for a railway line from West Point, on the York, to Urbanna, in Middlesex County, on the Rappahannock, a distance of about twenty-five miles. It is stated that the road is to be run with modern gasolene electric motor-cars, and will be a high-speed road traversing a section of the state now free of modern transportation facilities. Northern capitalists are said to be back of the enterprise.

OGDENSBURG, N. Y.—Representatives of New York capitalists are securing the consent of property owners to building an electric railway from this city through to Edwardsville, a distance of fourteen miles, thence across to Morristown and along the St. Lawrence River bank to Ogdensburg. The plan also contemplates a line from Edwardsville through Rossie to Gouverneur. Options will be secured later for a line from Ogdensburg to Canton, Potsdam, Massena, Louisville, Waddington and back to this city.

OKLAHOMA CITY, OKLA.—Officials of the Oklahoma City Street Railway Company are planning a number of extensions to be made within the next sixty days, to cost in the neighborhood of $50,000. John W. Shartel, vice-president and general manager of the company, has been in the East for some time looking after matters connected with improvements. It is stated that a line will be built to the state fair grounds in time for the fair in October. This line will be double track and will cost $40,000. The company is in a position to construct this line and have it in good running order by the latter part of September.

CINCINNATI, OHIO—Representative men of Erlanger, Ky., it is stated, have been at work for some time planning an extension of the Cincinnati, Newport & Covington Light and Traction Company from the St. Mary's Cemetery, on the Lexington pike, to Erlanger. Dr. James P. Riffe, who has been pushing the extension, says: "We had several interviews with Mr. Archibald White, the president of the company, and told him we would raise a subscription of $60,000 in four per cents, sufficient to pay for the extension. He assured us the extension under those conditions and it looks like a certainty now."

WELLSVILLE, OHIO—That the construction of interurban roads that will close all gaps between here and Columbus, Cleveland, Pittsburg and Cincinnati will be undertaken during the coming eight months is the belief of traction interests here. Now that a complete interurban system is open from Rochester, Pa., to Bellaire, a distance down the Ohio Valley of nearly 100 miles, attention is to be given immediately to the building of a line from Bellaire to Zanesville, on the Ohio side, and from Moundsville to Steelton, W. Va., a distance of twenty miles, and from Friendly to Williamstown, W. Va., a distance of thirty-seven miles.

GUTHRIE, OKLA.—Philadelphia capital is reported back of the proposed construction of the Oklahoma City-El Reno Electric Interurban Railway, and the work of grading is expected to commence November 15, according to statements by local promoters. The surveys have been completed between the two towns, and the work of acquiring right of way is going on gradually. A special election will be called in El Reno on the proposition for granting the street railway company a four-year extension on its franchise. The life of the franchise is twenty-one years, the company claiming that its bonds can be better disposed of if the company has a twenty-five-year franchise. The first mile of line has been completed and will be extended as soon as material arrives.

TUSCALOOSA, ALA.—The Birmingham & Gulf Construction Company has given up its contract to build the electric line from Tuscaloosa to Gadsden. By mutual agreement the contract was terminated. All of the equipment owned by the construction company has been turned over to the railroad. There have also been some changes in the officers of the Birmingham & Gulf Railway and Navigation Company. Mr. Vandergrift, who had been general manager, has been succeeded by J. T. Pultz, of New York, whose title will be general superintendent. E. F. Enslen, Jr., of Birmingham, has been appointed superintendent of the Birmingham & Gulf Railroad to succeed George H. Rois. Owing to the cancellation of the contract with the construction company the work on the line will be delayed for a short time. It is understood that a new contract will be arranged for an early conclusion.

BROOKLYN, N. Y.—The Long Island Railroad has applied to the Public Service Commission for its approval of the grant of a franchise to lay surface tracks on Atlantic avenue, Brooklyn, between Flatbush and Shepard avenues. The company claims a right of way through Atlantic avenue, but explains in the application that it is asking for a franchise for the reason that it does not wish to enter into litigation with the city. The company's claim to the right of way is based on its purchase of the rights of the old Brooklyn & Jamaica Railroad Company, which operated a surface line through Atlantic avenue. According to the application filed at this time the original grant to the Brooklyn & Jamaica Railroad Company was for a railroad from Greenpoint through Jamaica to the river's edge in Brooklyn for the term of 250 years. It is claimed that this grant gave the company "the perpetual use for railroad purposes of the thirty-foot strip in the centre of this portion of said avenue," the portion referred to being the greater length of the proposed route, and that, for the rest, a similar provision was made in the "tripartite agreement of 1855."

HOUGHTON, MICH.—At the annual meeting of the Houghton County Street Railway Company, held at the company's offices in Houghton, directors and officers for the ensuing fiscal year were elected. The election resulted as follows: President, F. J. Bawden; vice-president, F. S. Pratt; treasurer, Henry D. Sawyer; secretary, Alvah K. Todd; assistant treasurers, J. Harry Dufresne and Willard W. Dow; directors, C. A. Stone, T. E. Tripp, T. N. Perkins, Edwin S. Webster, Henry G. Bradlee, F. J. Bawden, Russell Robb, N. H. Stone and F. S. Pratt; executive committee, Henry G. Bradlee and Russell Robb. The only change made was that of F. S. Pratt in place of Henry G. Bradlee for vice-president. General Manager McGrath announced that articles of incorporation for the Houghton County Traction Company have been filed at Lansing. This company has been organized for the purpose of operating the Mohawk extension, and it is the intention of the company ultimately to take over the Houghton County Street Railway Company. The right of way for the Mohawk extension has all been secured, and nothing now stands in the way of completing the road, work on which is progressing rapidly.

BARRE, VT.—The Barre & Montpelier Power and Traction Company has closed a contract with Dornsife & Miglierini for the erection of a dam and power-house on the Winooski River, near Kinney's Mills, toward East Montpelier, that property and water rights having been purchased some time ago. When the work is completed the company will have sufficient power to run its cars between Barre and Montpelier and also for lighting purposes. It is planned to have the construction finished by November 1. The dam will be eighteen feet high and 178 feet long. Power will be transmitted from the East Montpelier side of the stream by a 600-foot penstock to the power-house, to be located near Gallup's bridge. This building will be of cement blocks and will contain two turbines, one of 350 horse-power capacity and the other of 600. There will be, in addition, an auxiliary plant, so that the company will be prepared for emergencies. At the annual meeting of the company F. M. Corry, E. H. Deavitt, I. M. Frost and T. J. Deavitt, of Montpelier, and H. K. Bush and D. M. Miles, of this city, were re-elected directors. Subsequently Frank M. Corry was re-elected president; E. H. Deavitt, clerk and treasurer; I. M. Frost, general manager, and H. K. Bush, vice-president. The reports showed that the business of the road increased during the past year. The capital stock is now $120,000.

ELECTRIC LIGHTING.

BOYERSTOWN, PA.—A site has been purchased for the proposed electric light plant, and a building forty by 100 feet will be erected.

MANCHESTER, MASS.—The proposition for the purchase of the Manchester Electric Light Company by the municipality has been defeated.

LOS ANGELES, CAL.—The directors of the Escondido Mutual Water Company have voted for the installation of an electric light and power plant to cost about $30,000.

POTTSVILLE, PA.—Contracts have been signed for the erection of a ten-mile electric transmission line in western Schuylkill. This will extend from Tower City to Lykens.

ARGENTA, ARK.—The city council has decided to expend $12,000 for additional machinery for the electric light plant to enable it to light for commercial purposes.

PASCO, WASH.—Fire destroyed the Northern Pacific Light and Power Company's plant on August 7. The plant was valued at $51,000, and was partly covered by insurance. The origin of the fire is unknown.

WASHBURN, WIS.—The city council has voted to annul the purchase of the electric lighting system from the Washburn Electric Light and Power Company. The city paid $22,580.40 for the plant but has been unable to make it pay.

ST. LOUIS, MO.—A municipal lighting plant, to supply the needs of the new city hall, municipal courts buildings and all city buildings in the downtown district, has been approved by Mayor Wells. The new plant is to cost $100,000.

SHERMAN, TEX.—At a meeting of the Sherman city council it was decided to draw up an ordinance in blank ordering an election for the issuance of bonds in the amount of $30,000, the proceeds to be used for improving the electric light and water systems.

BERLIN, MASS.—Berlin voted in special town meeting to authorize a special committee to make a contract for five years with the Marlboro Electric Light Company for electric lights in its streets. The same committee was empowered to act in regard to lighting the town hall.

PORTAGE, WIS.—Surveyors are running a line through Columbia County from Kilbourn for the Southern Wisconsin Power Company. By running through Portage, Wyocena, Rio and Columbus these towns will have the advantage of the power produced by the Kilbourn dam.

WEST CHESTER, PA.—The borough council of West Chester has made a new contract with the Edison Electric Illuminating Company to light the streets with 2,000-candle-power arc lamps at $75 each per year instead of $80 each, the price under the contract for the past five years.

CANTON, OHIO—Manager W. C. Anderson, of the Canton Electric Company, states that the contract for furnishing the city 185 arc lights or more on moonlight schedule at $41.50 per arc per year, has been returned to him from Philadelphia with the signatures of officers of the company.

MORRISTOWN, N. J.—The Morris & Somerset Electric Company has plans out for the addition to its power-house on Whippany street, made necessary for additional machinery for lighting the town, and it has taken over the Public Service Corporation's plant. Two additional 250-kilowatt generators will be put in.

MILFORD, MASS.—The Massachusetts Lighting Companies, of Boston, which operates the Milford Electric Light and Power Company, has petitioned the state gas and electric light commissioners for the right to issue $40,000 worth of first mortgage bonds to meet floating indebtedness and to further extend the local system.

MACON, GA.—By granting an amendment to the original charter, Judge Felton has allowed the Central Georgia Power Company to increase its capital stock from $100,000 to $400,000. At the same time the amendment was granted the name of the company was changed from Bibb Power Company to the Central Georgia Power Company.

ST. LOUIS, MO.—At a meeting of the United Light, Heat and Power Committee at the Planters' Hotel a subcommittee was named to make an inquiry into a proposition to build a municipal lighting plant. A resolution recommending that the city purchase the underground conduit system of the Union Electric Light and Power Company was adopted.

POTTSTOWN, PA.—Pottstown has closed a five-year contract with the Pottstown Light, Heat and Power Company for electric street lighting at the rate of $70 yearly for arc lights and $25 for incandescent, a reduction of $12.50 and $6.90, respectively, a saving to the borough of about $1,600 annually. The lighting company will make improvements costing between $15,000 and $25,000.

HOLYOKE, MASS.—The July figures for the lighting department show a gain in the output over the same month of 1,415,332 feet, or twelve and one-tenth per cent over last year. In the electric department the gain is also satisfactory, the output for last month being 360,880 kilowatts, as against 343,190 kilowatts for the same month a year ago. The greatest gain occurred in the commercial output, where a gain of twenty-four and four-tenths per cent was made.

OREGON CITY, ORE.—F. M. Swift, who is backing the project to construct an electric railway from Oregon City into the Beaver Creek, Molalla and Wilhoit Springs sections of Clackamas County, has filed notice of the appropriation of water from the main channel of the Molalla River. Swift proposes to build a canal or ditch, twenty-five feet wide at the bottom, thirty-three feet wide at the water surface, to carry an eight-foot depth of water, with a grade of two-tenths foot.

NOBLESVILLE, IND.—Ralph Wing, of Peru, and C. B. Shaber, of Arcadia, receivers for the Arcadia Electric Light Company, have reported to the court that they have sold the plant to the Noblesville Heat, Light and Power Company for $2,500, of which A. R. Holliday, of Indianapolis, is one of the largest stockholders. The court has approved the sale and discharged the receiver. The Noblesville company intends to supply Arcadia with current from Noblesville. It is already supplying Cicero and expects to extend the line to Atlanta.

WAHPETON, N. D.—Negotiations are about completed looking to the passage of a franchise which will bring water-generated electric light and power from a few miles this side of Fergus Falls, and will permit manufacturing at this railroad centre with cheap power. The total available power will be 2,000 horse. The Commercial Club has on foot a plan to connect by electric railway Sisseton with Wahpeton *via* Hankinson. The line would pass through some of the best farming land and most thickly settled country in the Dakotas, much of which is relatively far from any railroad.

ALBANY, N. Y.—The Public Service Commission has granted the application of the Williamsville Electric Light and Power Company for permission to construct and operate and exercise rights and privileges under franchises in the village of Williamsville. The order is granted upon the condition that the company will have its plant and lighting system completed and ready for supplying and distributing electricity on or before May 18, 1910. The commission has also granted the company authority to issue $25,000 of common capital stock to be used to acquire power-house and equipment. The company applied for permission to issue $35,000 stock.

CLINTON, MASS.—At a town meeting a resolution to the effect that the town acquire a plant for the manufacture and distribution of gas and electricity for municipal use and the use of its inhabitants was passed by a vote of 223 to twenty-seven. The committee that was appointed last May to investigate the subject submitted a report and was retained to make further investigation. The board of selectmen was instructed to communicate with the Clinton Gas Light Company and request them, according to law, to file with the town clerk a schedule of the property it desires to sell and the price it intends to charge. The committee's report gave some figures regarding the approximate value of the gas company's property and the result of a conference with the Metropolitan Water and Sewerage Board. From the latter the information was secured that power could be taken from the Wachusett dam at a charge of $15 per horse-power per year, and 2,500 horse-power would be available.

PERSONAL MENTION.

MR. EDWIN FERRIN has succeeded O. E. Bostick as superintendent of the Palestine Telephone Company, Palestine, Tex.

MR. CHARLES R. HUNTLEY, president of the Buffalo General Electric Company, was a visitor to New York last week in attendance at the funeral of the late Dr. William M. Habirshaw.

MR. F. H. KNOX has been made vice-president and general manager of the Electric Power and Manufacturing Company which owns and operates a street railway system, electric light and gas plants at Gaston Shoals, S. C.

DR. S. N. TAYLOR has been appointed head of the department of electrical engineering at the University of Cincinnati. Dr. Taylor has been professor of electrical engineering at the Western University of Pennsylvania for six years. Previous to that he was assistant professor of physics at Syracuse University.

MR. C. E. DUCK, formerly connected with the Waynesboro Electric Light and Power Company and Chambersburg, Greencastle & Waynesboro Street Railway Company, and who resigned from the service of the latter corporation some time ago, has accepted a position with the Carbon Transit Company, Mauch Chunk, Pa.

MR. FRANK J. QUINN, who for the past fifteen years has been associated with the Pacific Telephone and Telegraph Company as purchasing agent, and subsequently with the Western Electric Company as buyer, has become identified with the Sterling Electric Company, San Francisco, Cal., and will act as a director and treasurer of the company.

MR. ALBA H. WARREN, formerly manager of the Brockton & Plymouth Street Railway Company, of Plymouth, Mass., has assumed the management of the Pensacola (Fla.) Electric Company and the Escambia County Electric Light and Power Company, *vice* John W. Leadley, who is now on an extended vacation prior to taking up other work with the Stone & Webster interests.

MR. BEN S. REED, New Orleans manager of the Cumberland Telephone Company, has been appointed superintendent of the New Orleans district to succeed E. L. Powell, whose resignation has been announced. Mr. Reed has been in charge of the New Orleans exchanges since the beginning of this year, reorganizing the force and making many improvements. He has been manager at Owensboro, Ky.; at Chattanooga and at Louisville.

DATES AHEAD.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Arkansas Association of Public Utilities Operators. First annual convention, Little Rock, Ark., September 17-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-10.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Railway Signal Association. Next meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

ENGINEERING SOCIETY NOTE.

THE ELECTRIC CLUB OF CHICAGO—Mr. Clarence E. Freeman, of the Arnold Company, Chicago, Ill., addressed the Electric Club of Chicago on August 26 on the subject of "Irrigation and Power Development in the West."

ELECTRICAL SECURITIES.

The stock market developed considerable irregularity last week, with a distinct tendency to travel downward. Murmurings have been heard indicating that this was the result of manipulations carried on by the financial powers which have been instrumental in the upbuilding of the stock market for the past two or three months. The impression is gaining ground that a good deal of the trouble has been caused by the throwing over of investment stock which has been held for some time. The steel stocks contributed the real element of strength to the stock situation, while other metals were comparatively weak. This is essentially a period of marking time, and while the present outlook is favorable for a healthy market and increasing values, very little is being predicted one way or the other as to what turn will be made in the next two or three months.

Dividends have been declared upon the following electrical securities: Twin City Rapid Transit Company; regular quarterly dividend of 1¾ per cent on the preferred stock, payable October 1 to stock of record September 16. American Railways Company; regular dividend of 1½ per cent, payable September 15.

ELECTRICAL SECURITIES FOR THE WEEK ENDED AUGUST 22.

New York:	*Closing.*
Allis-Chalmers common	11¾
Allis-Chalmers preferred	34¼
Brooklyn Rapid Transit	51⅜
Consolidated Gas	135
General Electric	143
Interborough-Metropolitan common	11¼
Interborough-Metropolitan preferred	31⅝
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	66
Mackay Companies (Postal Telegraph and Cables) preferred	66½
Manhattan Elevated	135
Metropolitan Street Railway	28
New York & New Jersey Telephone	110
Western Union	55¼
Westinghouse Manufacturing Company	71

Boston:	*Closing.*
American Telephone and Telegraph	124⅞
Edison Electric Illuminating	216
Massachusetts Electric	47
New England Telephone	114
Western Telephone and Telegraph preferred	70

Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	38
Electric Storage Battery preferred	38
Philadelphia Electric	9¾
Philadelphia Rapid Transit	14
United Gas Improvement	87½

Chicago:	*Closing.*
Chicago Telephone	145⅛
Commonwealth Edison	108
Metropolitan Elevated preferred	43½
National Carbon common	72½
National Carbon preferred	108

NEW PUBLICATION.

A NEW BOOK ON ELECTRICAL ENGINEERING—Robson & Adee, of Schenectady, N. Y., are preparing for publication a new book on electrical engineering by Dr. Charles P. Steinmetz. This book contains a series of lectures delivered by Professor Steinmetz under the auspices of Union University, in the winter of 1907-1908, to a class of younger engineers consisting mainly of college graduates. The lectures give a broad review of the entire field of electrical power generation, transmission, distribution, control and use, showing the close relation and dependence upon each other of all of the factors of the problem.

EDUCATIONAL NOTE.

THE ROSE POLYTECHNIC INSTITUTE—The Rose Polytechnic Institute is one of the few special technical institutes in the West. It is located at Terre Haute, Ind., and under the presidency of C. L. Mees is maintaining a high standard of excellence. The institute occupies a large and completely equipped building within the city limits, and its work is both theoretical and practical, its equipment enabling it to give its students in civil, mechanical and electrical engineering an abundance of practical work.

TELEPHONE AND TELEGRAPH.

ONEIDA N. Y.—Ground will be broken shortly for a new building for the Central New York Telephone and Telegraph Company.

NASHVILLE, TENN.—The Western Union Telegraph Company has taken over the wires on the Tennessee Central Railway between Nashville and Hopkinsville, Ky., formerly operated by the Postal Telegraph Company, and will operate them hereafter.

SPENCERPORT, N. Y.—The Ogden Telephone Company, which was organized last winter, has now practically completed the construction of its system and is furnishing service to over 300 subscribers. The Milliner Building has been leased for the Spencerport exchange and two switchboards have been placed in the building.

WICHITA, KAN.—Surveys are being made for a trunk telephone line from this city to Abilene to connect the Oklahoma service with the up-state systems. The intention is to build a later one to Omaha. One already extends from Abilene to Kansas City. The capacity of this will be doubled. The expansion of the independent service among the farming communities makes trunk lines between the cities necessary for toll service.

CENTERVILLE, N. Y.—An association, to be known as the Centerville Telephone Company, has been organized, with J. C. Vosburg, president; Victor O. Crowell, secretary, and Nelson Hauber, treasurer. Its purpose is, first, to put up a line from the postoffice to the Buffalo & Susquehanna Railroad station; second, to extend a line to Fairview, four miles from here, and to create a system to cover the town of Centerville and connect with the Inter-Ocean at Rushford.

LITTLE ROCK, ARK.—The Valley Telephone Company, of Warren, contemplates an extension of its system from Warren to Dermott, *via* Monticello, a distance of forty miles. The company has 600 miles of pole line, 100 stations, thirteen exchanges and operates in seven counties. It has connection with the Cumberland at Greenville, Miss., and Lake Providence, La., and with the Southwestern Telegraph and Telephone Company at Fordyce and Pine Bluff, and has a cable across the Mississippi at Greenville. It sub-leases its instruments from the Southwestern.

REDLANDS, CAL.—A long-distance telephone line from Redlands Junction to El Paso, a distance of about 750 miles, is to be built this fall by the Consolidated Telegraph and Telephone Company, of Tucson, Ariz. The line will be the longest of the kind in the West, and a branch line which will tap the mining district of Arizona and the Imperial Valley will make the entire length 1,009 miles. The cost will be approximately $250,000. Charles A. Rolfe, of Redlands, who is identified with the Southwestern Company, of this city, has been given the contract and expects to begin work in about three months. Although the contract reads "To Redlands Junction only," the terminal point, of course, will be Los Angeles. Mr. Rolfe says it has not been decided with which company connections will be made in that city. In the construction of the line over 880,000 pounds of copper wire will be used and more than 50,000 poles.

NEW MANUFACTURING COMPANIES.

DOVER, DEL.—A charter has been filed for the Steven D. Large Company, Incorporated, Philadelphia, Pa., to engage in a general electrical engineering business. The capital is $10,000.

COLUMBUS, OHIO—The Browne-Cross Company, of Columbus, has been incorporated with a capital stock of $10,000, by Morton S. Browne, S. E. Browne, Charles W. Cross, H. H. Wilson and F. H Heywood. The company will manufacture and deal in electrical devices.

SEABRIGHT, N. J.—The Atlantic Coast Electric and Protective Company has been incorporated to manufacture burglar-alarm apparatus, with a capital of $10,000. The incorporators are: P. Hall Packer, Seabright, N. J.; Joseph Swanson, James Otterberg, New York city.

ALBANY, N. Y.—Camden & De Young, Incorporated, have filed incorporation papers with the secretary of state to carry on business as electricians, electrical engineers and general contractors. The capital is $20,000 and the directors are William Kelly, Leonard De Young and Fred Raff, of New York.

INDUSTRIAL ITEMS.

THE H. KRANTZ MANUFACTURING COMPANY, 160 Seventh street, Brooklyn, N. Y., is mailing a card calling attention to the features of the type P. C. knife switch.

THE WESTINGHOUSE TRACTION BRAKE COMPANY, Pittsburg, Pa., has ready for distribution instruction pamphlet No. T-5035, devoted to the A M S brake equipment.

THE CHICAGO PNEUMATIC TOOL COMPANY, Fisher Building, Chicago, Ill., has ready for distribution advance sheets from its catalogue No. 26, devoted to Franklin air-compressors.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has issued several supplements to its instruction book 5,007. These are devoted respectively to supply parts for potential starters, type A1, type A2, type B1 and type B2.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., has begun the publication of a little monthly entitled "Hot Points." This contains some very interesting matter concerning the electrical heating apparatus manufactured by this company.

THE NILES-BEMENT-POND COMPANY, 111 Broadway, New York city, has published a handsome catalogue devoted to Niles boring mills. Some of the illustrations show exceptional applications of electric motors to the direct driving of these important machine tools.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued bulletin No. 81, devoted to central-station transformers. This takes up, in a very careful way, an analysis of the use of the new "alloy steel," with which all Wagner "Standard" and "High-Efficiency" transformers are now built. The use of this steel has resulted in marked advantages.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution bulletins No. 3,134 and No. 3,306, devoted, respectively, to single-phase induction motors, frame 24 DA, one-fortieth and one-twentieth horse-power, light-load start type, for intermittent service, and electric blowers for furnaces for alternating or direct currents.

THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, Cleveland, Ohio, in the August issue of its attractive little bulletin, "Common Sense," devotes some descriptive matter and illustrations to the electric fault finder which the company is now calling attention to. Of course, there is the usual matter which has attracted so much attention to this excellent publication.

THE PITTSBURG TRANSFORMER COMPANY, Pittsburg, Pa., is announcing its new silico-vanadium steel transformers. The company has also completed its final designs based on the remarkable characteristics of this new alloy. The company states that core losses in Pittsburg transformers have been reduced thirty to fifty per cent, and improved copper losses and regulation have also been secured.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has recently completed delivery on a large number of New Lexington high-tension porcelain insulators for use on the lines of the Sanitary District of Chicago. These insulators are of a new type, being fired by natural gas, and they are fully described in the insulator book which the company is now distributing. Copies of this book will be sent upon request.

THE RAILWAY SPECIALTY AND SUPPLY COMPANY, Chicago, Ill., has published bulletin T-228, describing and illustrating the Smith improved nut. This nut is made of spring steel, oil tempered. The bore of the spring end is larger than the root of the nut thread. When the nut is set tight home the spring is compressed until it rests against the main body of the nut. In this position it exerts a constant heavy pressure between the nut and the parts being held, which forces one side of the nut threads against the corresponding side of the bolt threads.

THE WYCKOFF PIPE AND CREOSOTING COMPANY, INCORPORATED, 50 Church street, New York city, states that the Degnon Contracting Company has recently removed one block of its conduit, twenty-four-duct run, the property of the Empire City Subway Company, from Sixth avenue, between Eighteenth and Nineteenth

streets, New York city, owing to excavation for the Hudson River tunnels. This conduit was laid in the year 1887 and was removed in June, 1908. After twenty-one years it was sound and without the least sign of decay in any instance. The company has documentary proof of the above facts, and has samples on exhibition at its New York office which it will be pleased to show to any interested party. This conduit is being stored, as it was taken up without breakage, except a portion where it was inexpedient to pull the cables and interrupt the service.

TUNGSTEN LAMP PRICE REDUCTION—The General Electric Company announces that after September 1 there will be an extra discount of ten per cent allowed on all purchases of tungsten lamps in standard package quantities. This additional discount is made to cover all losses incident to breakage in shipment, careless handling, early burnouts, etc., and does away with the necessity of adjusting such claims with the consumer. A careful record has been kept to determine the value of the special resilient packing cases used by the General Electric Company, and the average transportation breakage in six months has been less than two per cent. Another advantage to the consumer of a different character also goes into effect the first of the month. This is a general rearrangement of the delivery schedule. Thereafter all standard package shipments to points east of the Mississippi River will be made with transportation charges allowed, and for other points, excepting a few specially designated free delivery places, a small addition to the net price will be made. The company has four factories manufacturing tungsten lamps exclusively and has a combined capacity of 35,000 lamps a day, while ample stocks are carried at eleven different district sales offices to insure prompt deliveries to any part of the country.

Record of Electrical Patents.

Week of August 18.

896,081. TELEPHONE CALL REGISTER. Byron B. Brockway, Cleveland, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. The register is made a part of, and attached to, the diaphragm containing receptacle.

896,092. ELASTIC SUSPENSION FOR THE FILAMENTS OF ELECTRIC INCANDESCENT LAMPS. Paul Druseidt, Remscheid, Germany. The stem is spring-supported in three different places.

896,103. TELEPHONE SYSTEM. Charles L. Goodrum, Philadelphia, Pa., assignor, by mesne assignments, to the Dean Electric Company, Elyria, Ohio. A metallic-circuit central exchange and substations.

896,120. ELECTRICALLY OPERATED VALVE. Christian Krämer, Frankfort-on-the-Main, Germany, assignor to Felten & Guilleaume-Lahmeyerwerke Actien-Gesellschaft, Frankfort-on-the-Main, Germany. The closure is effected by means of a stem working in an electromagnet.

896,122. PLURAL LAMP SOCKET. Edward A. Lefèbre, Jr., Brooklyn, N. Y. The threaded base is equipped with a plurality of contact shells and socket-held plates.

896,130. RECEIVER FOR WIRELESS TELEGRAPHY. Guglielmo Marconi, London, England, assignor to Marconi Wireless Telegraph Company of America, New York, N. Y. The oscillation valve and primary winding of the induction coil are connected in series with each other, but in shunt with the condenser.

896,144. ELECTRODE. Harry Pauling, Gelsenkirchen, Germany, assignor to the firm of Salpetersäure-Industrie-Gesellschaft, G. M. B. H., Gelsenkirchen, Germany. Melted oxides are formed and maintained in their liquid state by the treatment of gases by arc discharges.

896,165. FAN. Otto Selg, New York, N. Y. The fan is fitted with an annular slitted deflector having a series of V-shaped blades.

896 173. TELEPHONE APPARATUS. James H. Thompson, Trenton, N. J. The bell box is provided with a drum for winding up the slack telephone cord.

896,184. APPARATUS FOR THE ELECTROLYSIS OF FLUIDS. Emil Weichert, Augsburg, Germany. The electrodes are fitted in conjunction with the convolution of each coil.

896,188. SYSTEM OF STORAGE-BATTERY CONTROL. Edward Wray, Janesville, Wis. An electromagnetic latch holds the switch arm locked when a battery is being charged.

896,189. ELECTRIC TROLLEY. John Young, Toledo, Ohio. The trolley wheel is carried in an eccentrically mounted case suspended from the trolley harp.

896,192. TERMINAL PIECE FOR ELECTRIC CIRCUIT-BREAKERS. Christian Aalborg, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The terminal piece is composed of a plurality of cylindrical radially slotted lamina having an inwardly tapered open end.

896,198. TROLLEY POLE. Lawrence C. Collins and Arthur R. Eltom, Cranford, N. J. The self-seating trolley pole is provided with inner and outer telescoping members.

896,200. BRANCH CONNECTION FOR ELECTRIC CABLES. John J. Dossert, New York, N. Y., assignor, by direct and mesne assignments, to Dossert & Company. The conducting yokes are adapted to be brought into contact with the cable on diametrically opposite sides.

896,210. CONTACT MEMBER. Henry D. James, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. An end recess engages with a projecting plug of materially smaller section, located in the recess of a co-operating contact member.

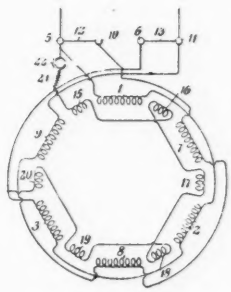
896,216. ELECTRICALLY PROPELLED VEHICLE. Louis Krieger, Paris, France. The battery, through a resistance, floats in the generator circuit.

896,217. WINDING FOR SINGLE-PHASE INDUCTION MOTORS. Fred R. Kunkel, Edgewood Park, Pa., assignor to Westinghouse Electric and Manufacturing Company. The main winding of the motor is adapted to be connected in either series or parallel relation with an auxiliary winding.

896,218. ELECTRIC WELDING MACHINE. Laurence S. Lachman, New York, N. Y. A spot-welding pole connected to a source of current, and a cross-sectional area large enough to give it rigidity.

896,220. ELECTRIC LOCOMOTIVE. Benjamin G. Lamme and Norman W. Storer, Pittsburg, Pa., assignors to Westinghouse Electric and Manufacturing Company. The axle is mounted upon quills, and the motor is resiliently connected to the axle.

896,222. ELECTRICAL MEASURING INSTRUMENT. Paul MacGahan, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A graphic recording meter.



896,217.—WINDING FOR SINGLE-PHASE INDUCTION MOTORS.

896,225. MEANS FOR AUTOMATICALLY RESTORING A TROLLEY WHEEL TO THE WIRE. Charles F. Mehl, Cleveland, Ohio. An auxiliary wheel carried upon a solenoid-operated plunger finds the position on the wire for the main trolley wheel.

896,227. MEANS FOR REGULATING THE SUPPLY OF ELECTRIC CURRENTS. Charles M. P. Montbarbon, Paris, France. One terminal of the generator armature is grounded and electrically connected through contact plates connected to the other terminal of the armature.

896,243. GAS OR VAPOR ELECTRIC APPARATUS. Max von Recklinghausen, New York, N. Y., assignor to Cooper Hewitt Electric Company. A continuous conductor is hermetically sealed in a container in an intervening gas or vapor.

896,249. ELECTRIC MOTOR CONTROL. Girard B. Rosenblatt, Butte, Mont., assignor to Westinghouse Electric and Manufacturing Company. Means for coupling together two asynchronous motors.

896,252. MEANS FOR ATTACHING METALLIC FILAMENTS TO THEIR CARRIER ARMS. Johannes Schilling, Halensee, near Berlin, Germany. The stem is provided with carrier arms.

896,274. ARC LAMP. Guy N. Chamberlin, Lynn, Mass., assignor to General Electric Company. The movement of the electrode automatically varies the rate at which air is supplied to the inner globe.

896,297. ELECTRIC HEATER. Edward M. Hewlett, Schenectady, N. Y., assignor to General Electric Company. The grid-shaped resistance strip is folded back and forth upon itself in parallel sections.

896,300. ELECTRICAL TESTING INSTRUMENT. Cameron De Witt Jarvis, Winthrop, Mass., assignor to American Telephone and Telegraph Company. The contact clips terminate in a cartridge containing a resistance coil and an indicating member.

896,319. CURRENT COLLECTOR FOR ELECTRIC RAILWAYS. Philipp Pforr, Lankwitz, near Berlin, and Paul E. Herkner, Berlin, Germany. The current collectors are operated by fluid pressure mechanisms.

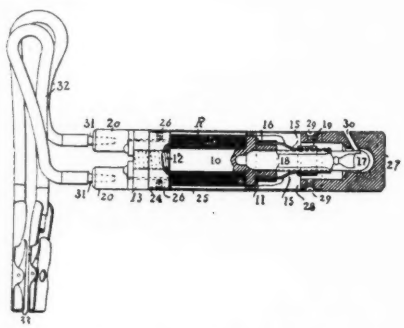
896,321. FIELD-MAGNET STRUCTURE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. The structure is composed of alternate large and small polygonal units each comprising a plurality of lamina riveted together.

896,322. DYNAMOELECTRIC MACHINE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. The laminated pole piece is equipped with removable tips.

896,323. DYNAMOELECTRIC MACHINE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. The field magnet is made up of staggered long and short polar portions.

896,332. AUTOMATIC TRAIN STOP. Hiram G. Sedgwick, Mill Valley, Cal. The stop mechanism on the train is actuated by an electromagnet placed in the roadbed.

896,341. FILAMENT FOR INCANDESCENT LAMPS. Willis R. Whitney, Schenectady, N. Y., assignor to General Electric Company. The filament is formed substantially of a nitride of a rare earth metal.



896,300.—ELECTRICAL TESTING INSTRUMENT.

896,348. CIGAR LIGHTER. Eskil Berg, Schenectady, N. Y., assignor to General Electric Company. The heating unit is contained in a capsule covered by a perforated shield.

896,350. STORAGE-BATTERY ELEMENT. John Bimeler, Zoar, Ohio, assignor of one-tenth to the Zoar Battery Company, Zoar, Ohio. The element is built up of a leaf structure, forming an open-work frame of large active area.

896,397. PENCIL AND APPARATUS FOR PRODUCING THE ARC LIGHT. Isador Ladoff, Cleveland, Ohio, assignor of thirty one-hundredths to Philip C. Peck, New York, N. Y. The electrode is composed of copper and titanium, and an alloy of copper and titanium.

896,416. TELEGRAPHONE. Hermann Schütte, Wheeling, W. Va. The speed of the telegraphone disc is adjusted by a clockwork and spring mechanism.

896,417. ARC LAMP. Ralph Scott, Wilkes-Barre, Pa., assignor to Scott Electrical Company. The feeding mechanism is actuated by a magnet.

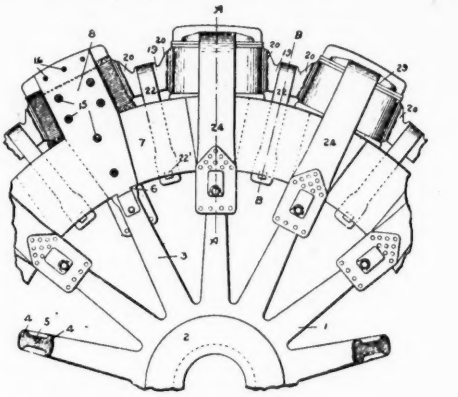
896,429. ELECTRODE FOR ELECTRIC FURNACES. Frederick M. Becket, Niagara Falls, N. Y., assignor by mesne assignments to Winthrop Chanler. The electrode has a metallic body portion, the interior of which is hollow or chambered, and an exterior coat or shell of carbon.

896,463. FIREPROOF SUPPORT FOR ELECTRICAL WIRES IN RAILWAY CARS. Edward T. Robinson, St. Louis, Mo., assignor to St. Louis Car Company, St. Louis, Mo. An insulating molding strip with a conduit for angle and corner work.

896,469. MAGNETIC CIRCUIT-BREAKER. Ralph Scott, New Brunswick, N. J., assignor to Scott Electrical Company. The contact members have recesses and prominences in their opposing faces.

896,476. CRIMPING APPARATUS FOR ELECTRIC WELDING MACHINES. Herbert L. Smith, Clinton, Mass., assignor to Clinton Wire Cloth Company, Boston, Mass. The apparatus is adjustable for making a crimp of any desired proportions.

896,516. MOTOR-CONTROL SYSTEM. Herbert W. Cheney, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. The single controller is arranged so that it can control either of the two motors separately, but is prevented from controlling them both together, and can leave one motor running while it controls the other.



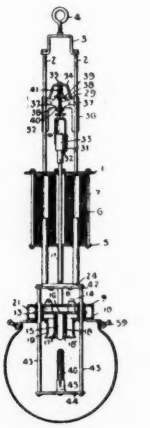
896,323.—DYNAMOELECTRIC MACHINE.

896,555. ELECTROLYTIC CELL. Gilbert C. Landis, York, Pa. A container having a number of removable frames, each frame being provided with a plurality of plates parallel to each other.

896,584. ELECTRICAL APPARATUS FOR TRANSMITTING SIGNALS. Charles Salmon and Henry J. Creffield, Erith, England, assignors to Vickers Sons & Maxim, Limited, Westminster, England. The several indicating stations are in series with the central signaling system.

896,586. MAKE-AND-BREAK DEVICE. Dominic Sandretto, Ladd, Ill. A bar pivotally mounted operates a step-by-step mechanism upon the energizing of an electromagnet.

896,608. ARRANGEMENT OF THE WINDING OF ELECTRO-MAGNETIC CLUTCHES. Heinrich Ast, Vienna, Austria-Hungary, assignor to the firm of Vulkan Maschinenfabriks-Actien-Gesellschaft, Vienna, Austria-Hungary. The magnet body contains an annular channel-shaped casing adapted to retain the winding.



896,698.—ARC LAMP.

896,617. TELEPHONE SWITCHBOARD APPARATUS. Lewis A. Brinkman, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. An operator's key shelf equipped with listening and ringing key, visual signal, and plugs.

896,630. ELECTRICAL HEATING MEANS FOR MOLDS. Harry E. Diller, Oak Park, Ill. The metal forms a part of the electrical conducting circuit.

896,698. ARC LAMP. Charles P. Steinmetz and John T. H. Dempster, Schenectady, N. Y., assignors to General Electric Company. One electrode is moved by gravity and the other by an electromagnet.